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NASA

EOS/AMSU-A
NASA/Aerojet Interface Meeting

11 May 1993

NASA

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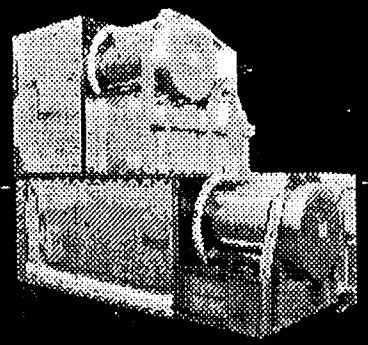
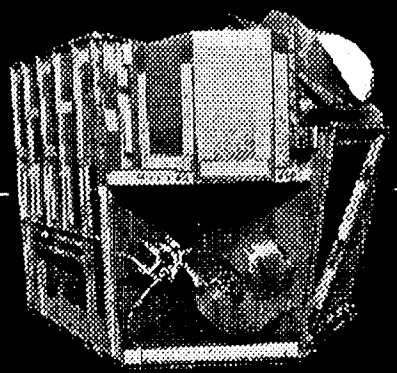


EOS AMSU–A1



EOS AMSU–A2

193-1500M1

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Agenda - NASA/Aerojet EOS/AMSU-A Interface Meeting

NASA

• Introduction	M. Domen/ D. Howell
• Instrument & Changes - Overview	W. Chapman
• Mechanical Requirements	
– Envelope, Access, Handling, FOV, Alignment	W. Chapman
• Recommended UIID Changes	
• Recommended IDD Changes Inputs	
– Mounting, Mass Properties, Structures, Torque	W. Ely
• Thermal Requirements	R. Krylo
• Electrical Command & Data Handling	M. Pluck
• Contamination	L. Santos
• Software	D. Howell

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Agenda - NASA/Aerojet EOS/AMSU-A Interface Meeting (cont)

NASA

• Integration & Test	W. Chapman
– UIID Changes/Inputs	
– IDD Changes/Inputs	
• Environmental Requirements Assessments	
– Vibration, Acceleration, Shock Launch Pressure, Acoustics	W. Ely
– EMI/EMC & Magnetic	M. Pluck
• Summary	D. Howell
• Action Item Summary	M. Domen

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Meeting Objectives

NASA

- **Provide All Data Required To:**
  - **Allow NASA To Complete The UIID And IDD**
  - **Allow Aerojet (PM&TL's) To Sign The UIID & IDD In June 1993**
- **Inputs Therefore Address:**
  - **Recommended Changes To UIID**
  - **Recommended Changes & Additional Input ("TBD" Resolvers) For IDD**
- **Primary Guideline Was, "Don't Leave Anything In Your Gut - We "Sign-up" In June - Get All Inputs Made & Questions Resolved."**

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EOS/AMSU-A
Instrument Overview

Use Of Two Separate Modules Accommodates The Widely Separated AMSU-A Frequencies

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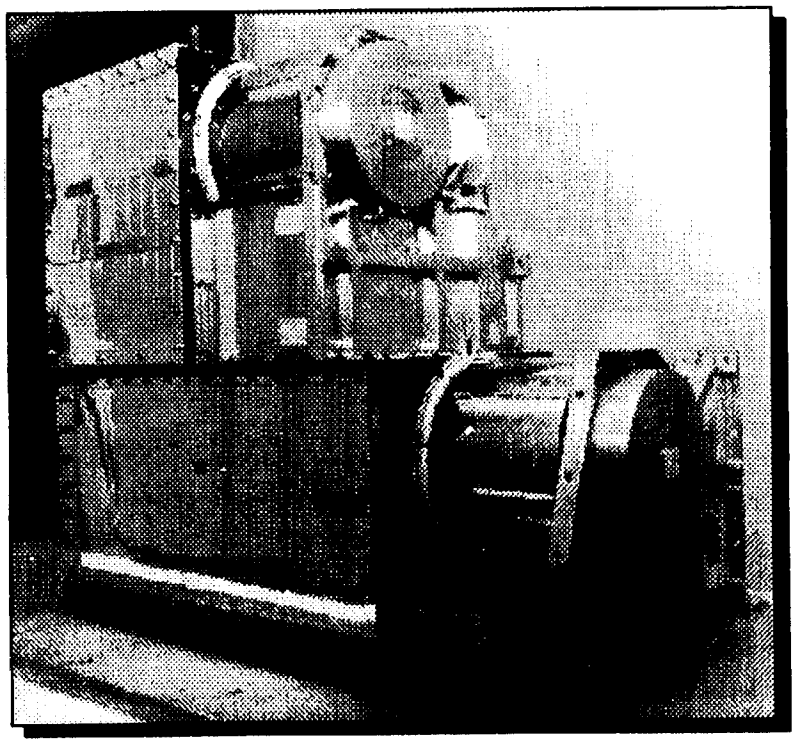
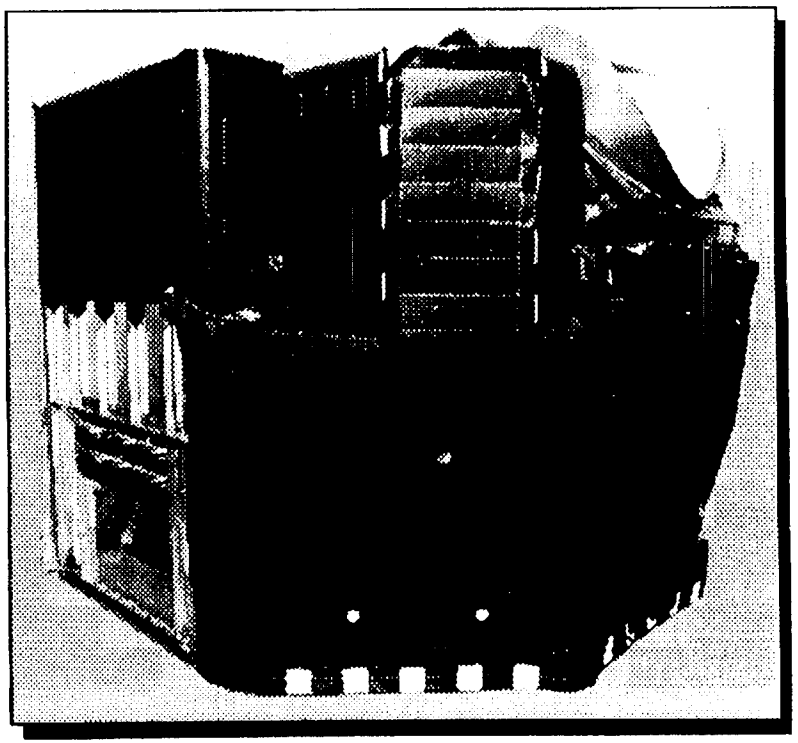
Channels 3-14 Provide Vertical Temperature Profile Of Atmosphere
Channels 1, 2, And 15 Are For Studying Atmospheric Water



AMSU-A1
V And W Band Frequencies
Channels 3-15



AMSU-A2
K And Ka Band Frequencies
Channels 1 & 2

493-1852M5- 8

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EOS/AMSU-A Channel Characteristics and Performance Requirements

NASA

Channel Number	Center Frequency (MHz)	Number of Passbands	Max Band-width (MHz)	Center Freq Stab. (MHz)	NEΔT (K)	Calib Acc (K)	Half-Pwr Beam Diameter (deg)
1	23800	1	270	10	0.30	2.0	3.33
2	31400	1	180	10	0.30	2.0	3.33
3	50300	1	180	10	0.40	1.5	3.33
4	52800	1	400	5	0.25	1.5	3.33
5	53596 ± 115	2	170	5	0.25	1.5	3.33
6	54400	1	400	5	0.25	1.5	3.33
7	54940	1	400	5	0.25	1.5	3.33
8	55500	1	330	10	0.25	1.5	3.33
9	$57290.344 = f_{LO}$	1	330	0.5	0.25	1.5	3.33
10	$f_{LO} \pm 217$	2	78	0.5	0.40	1.5	3.33
11	$f_{LO} \pm 322.4 \pm 48$	4	36	1.2	0.40	1.5	3.33
12	$f_{LO} \pm 322.4 \pm 22$	4	16	1.2	0.60	1.5	3.33
13	$f_{LO} \pm 322.4 \pm 10$	4	8	0.5	0.80	1.5	3.33
14	$f_{LO} \pm 322.4 \pm 4.5$	4	3	0.5	1.20	1.5	3.33
15	89000	1	3000	50	0.50	2.0	3.33

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Overview of Changes

NASA

- Electrical Interface
  - Redundant Power Bus
  - MIL-STD-1553 Redundant Data bus
  - ESTOL Software for Spacecraft Interface
- Thermal Environment
  - 705-km Orbit
  - Different Surroundings
- Performance Assurance
  - Contamination Control
  - QA and Workmanship Standards
- AMSU-A1 to Be Bottom Mounted
- AMSU-A2 Requires No Momentum Compensation

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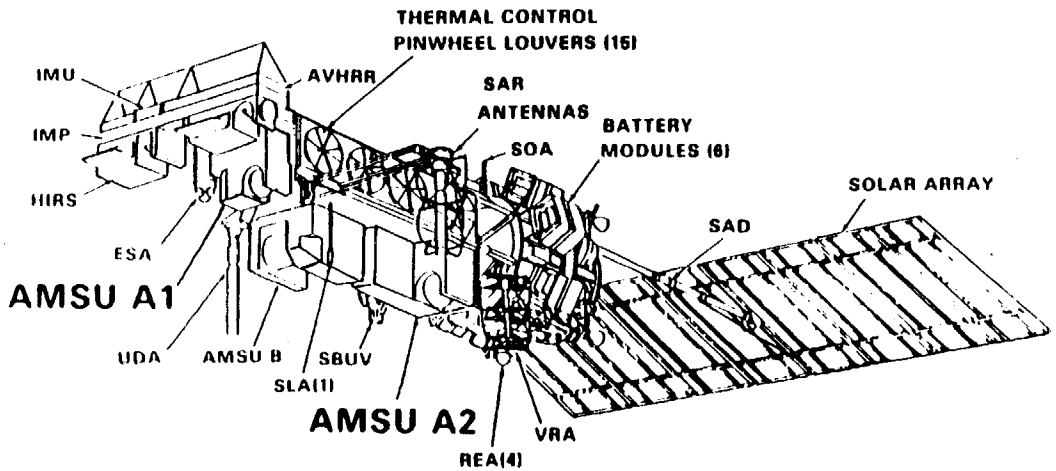
Primary Interface And Design Drivers For EOS/AMSU-A

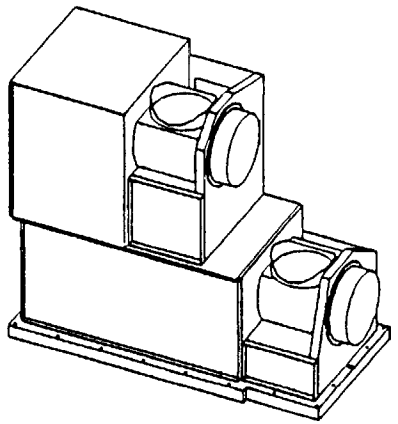
NASA

NOAA SPACECRAFT CONFIGURATION

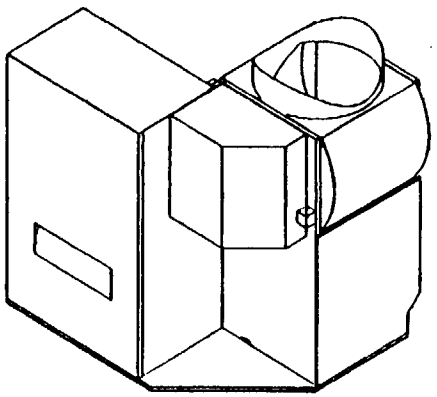


- Unit Configuration-Two Modules, Footprints Dictated By Existing NOAA Spacecraft
- Microwave Field Of View - Clear Views Of Earth (Mission) And Space (Calibration)
- Thermal Field Of View - Views Of Space And Other Instruments Establishes Thermal Conditions
- Command And Data Handling - MIL-STD-1553
- Power Interface - Redundant Power Buses
- Contamination Requirements - Especially Avoiding Contamination Of Other Instruments (Such As AIRS)

AMSU-A1



AMSU-A2



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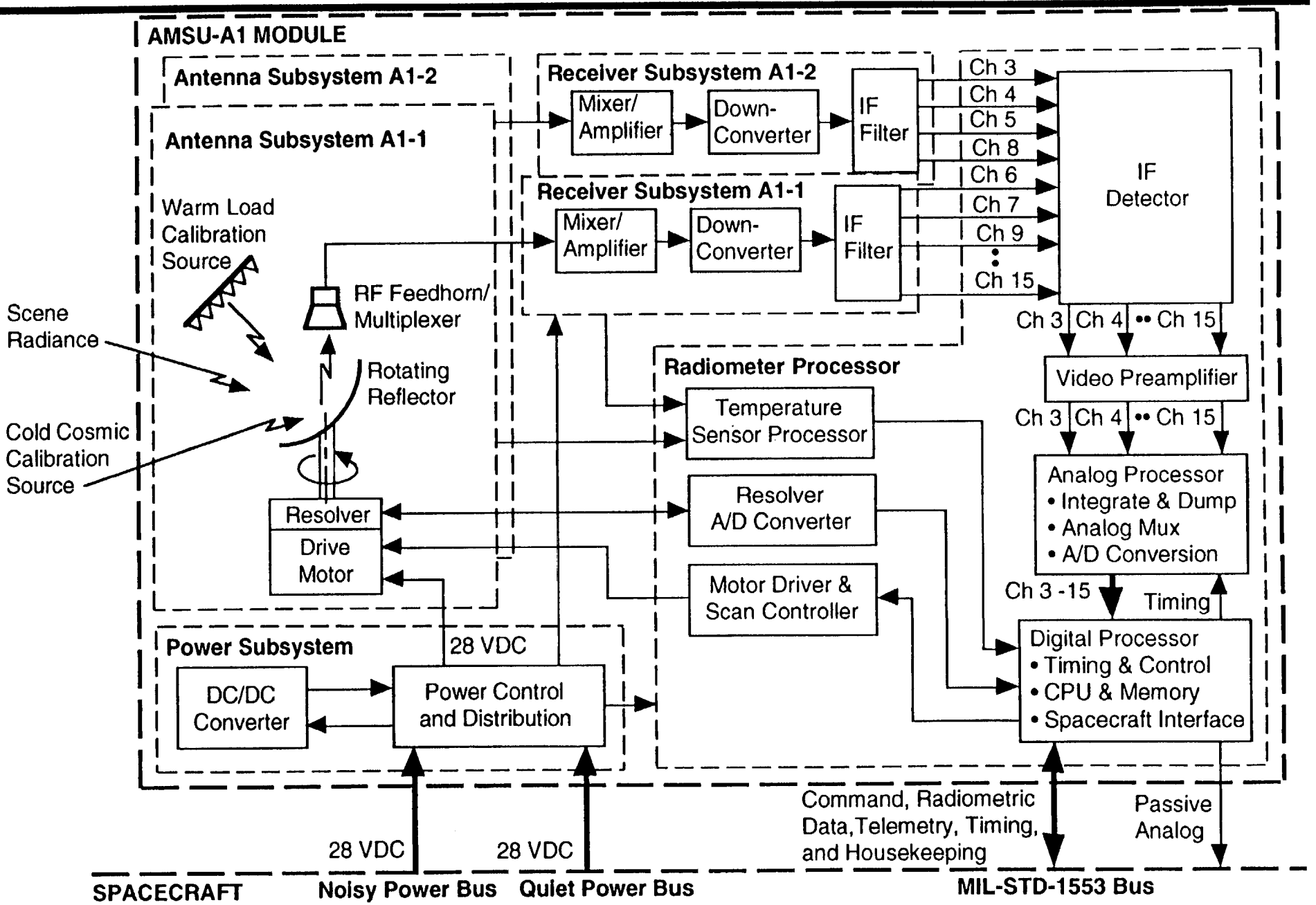
EOS/AMSU-A1 Functional Block Diagram

NASA



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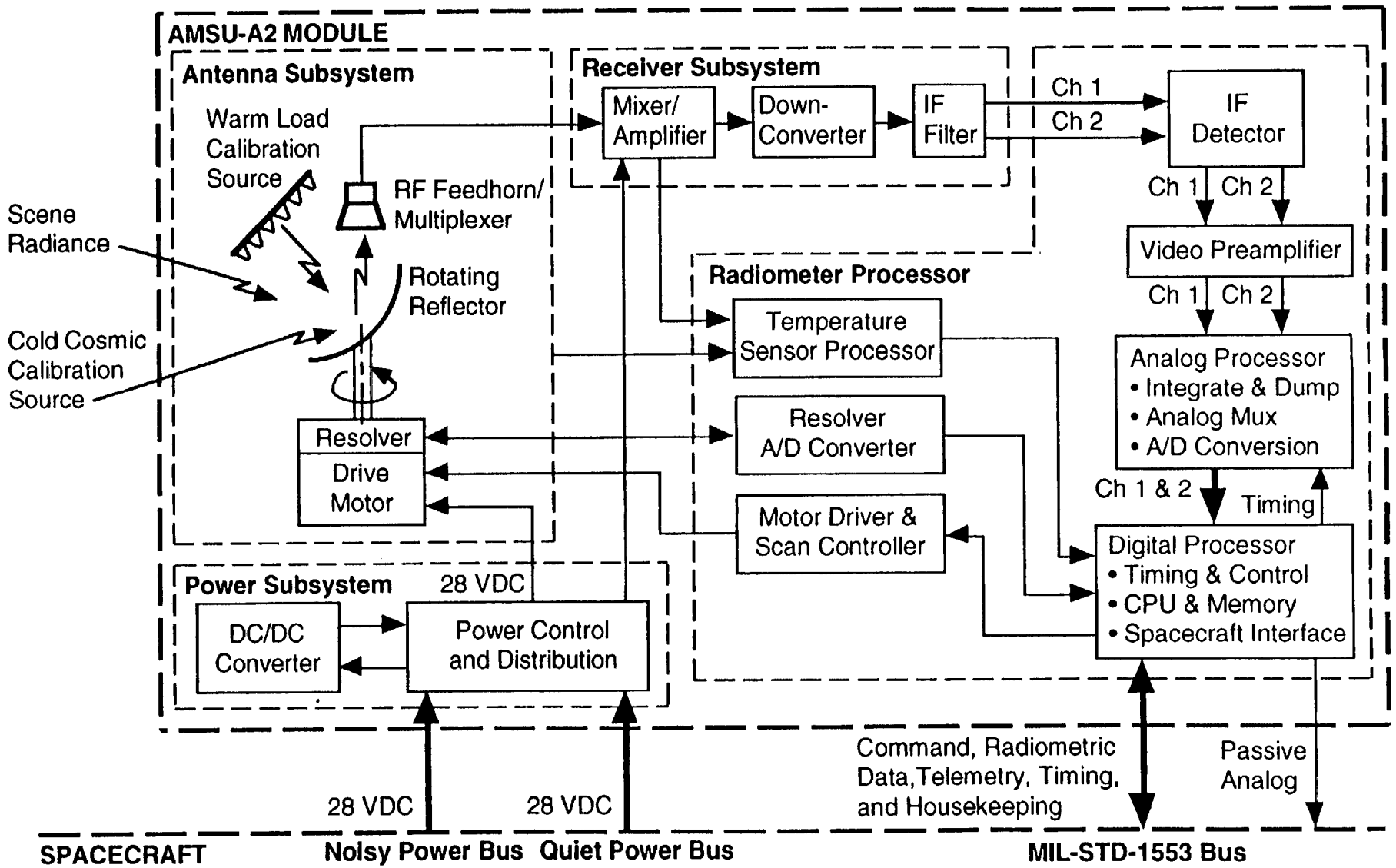
EOS/AMSU-A2 Functional Block Diagram

NASA



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EOS/AMSU-A Mechanical Requirements

Envelope, FOV, Alignment and Systems Considerations

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Agenda, System and Mechanical Interface - Weldon Chapman

NASA

- Recommended UIID Changes
- Recommended IDD Changes
- Action Item Dispositions

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Recommended UIID Changes

NASA

- Instrument Envelopes
- Fields of View
- Instrument Beam-pointing Budget

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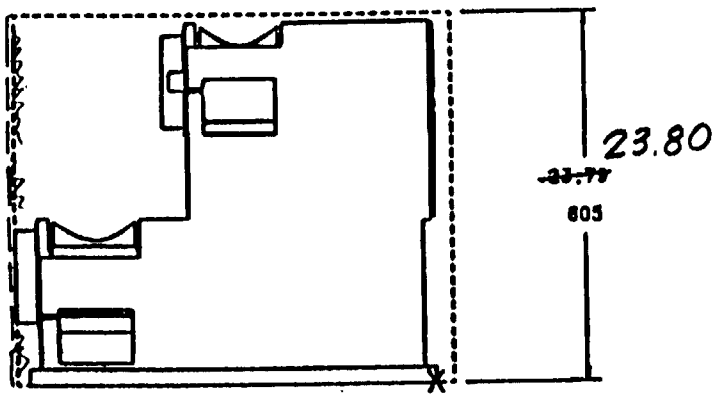
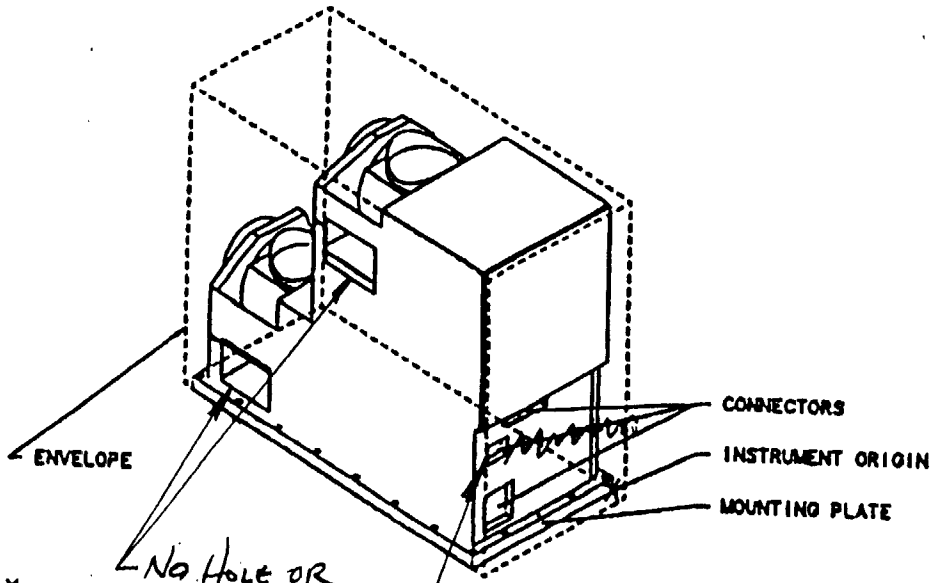
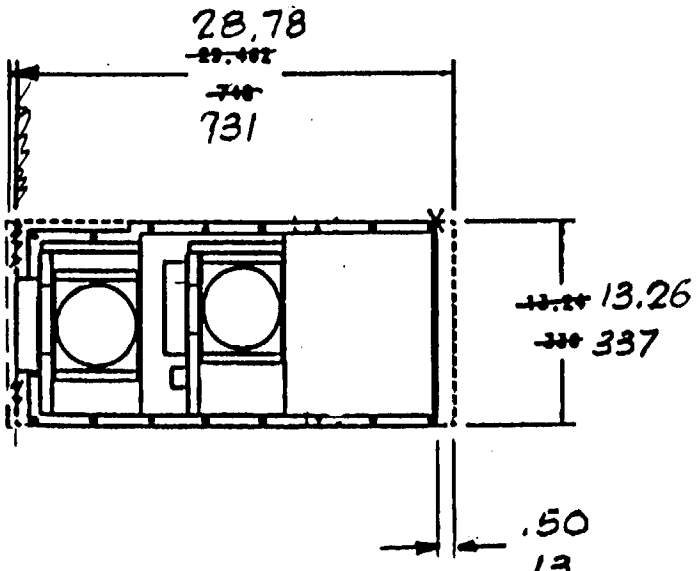
Recommended Changes to AMSU-A1 Instrument Mechanical Envelope Allocation- Figure 1 of UIID

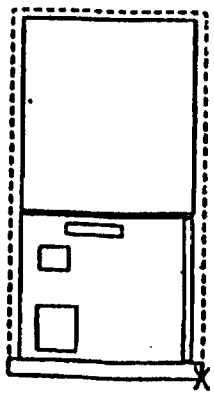
NASA





TOP ISOMETRIC VIEW





PLLO ADJUSTMENT COVER - ACCESSIBILITY REQUIRED THROUGH SPACECRAFT INTEGRATION AND CHECKOUT

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Recommended Changes to AMSU-A2 Instrument Mechanical Envelope Allocation - Figure 2 of UIID

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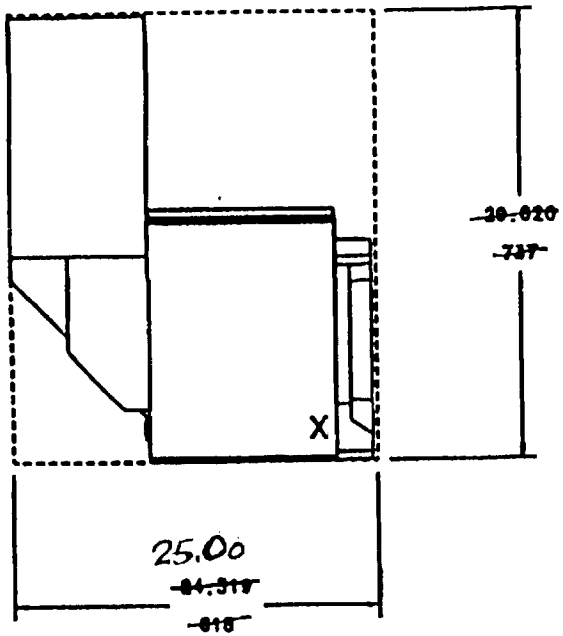
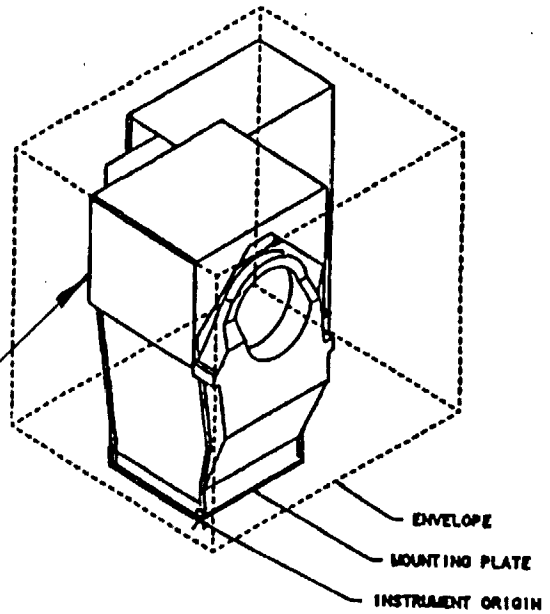
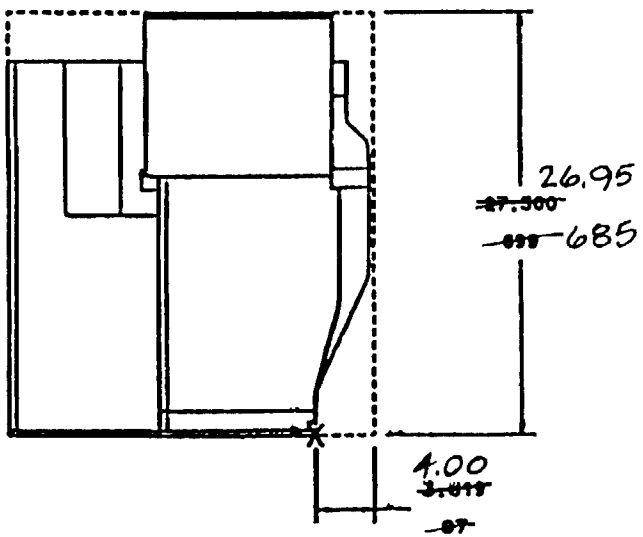
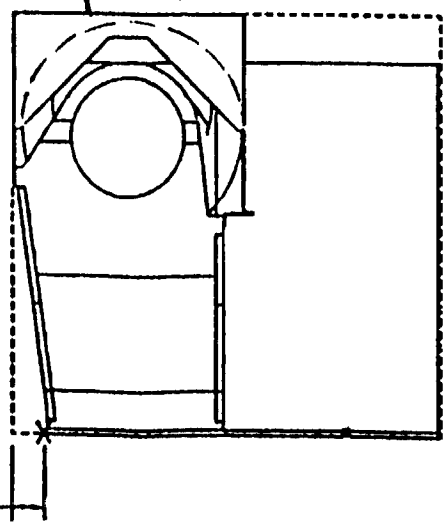


PROTECTIVE COVER - NOT FLIGHT HARDWARE



TOP ISOMETRIC VIEW





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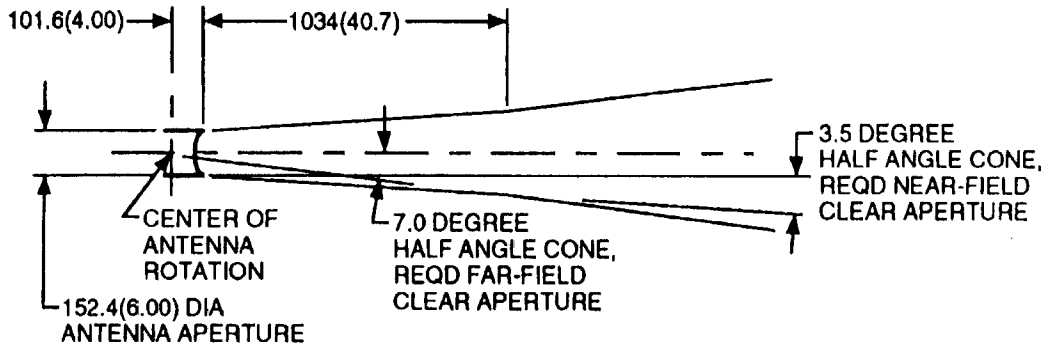
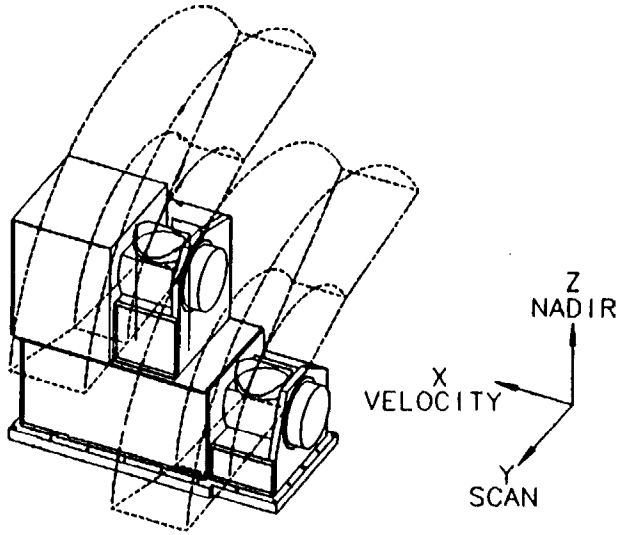
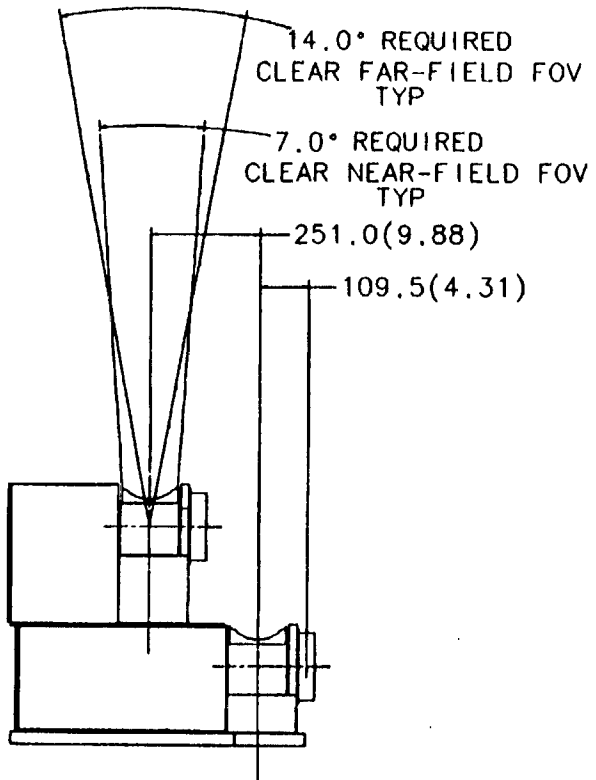
Recommended Considerations for the AMSU-A1 Field-of-View Allocation - Figure 3 of UIID

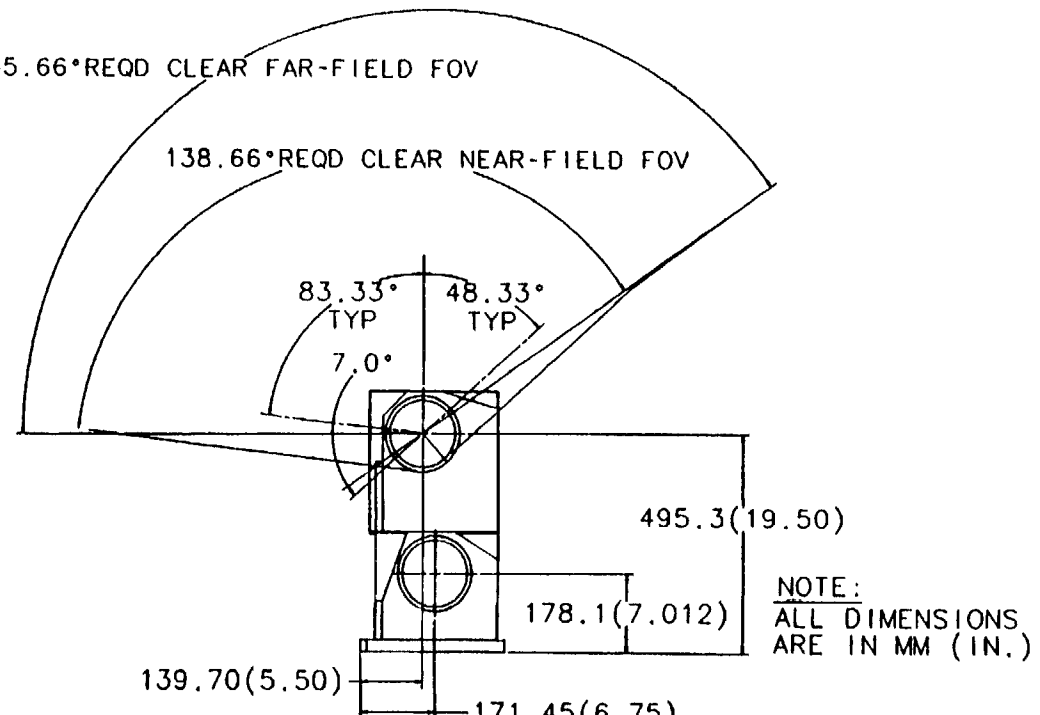
NASA





REQUIRED ANTENNA INSTANTANEOUS SOLID ANGULAR FIELD OF VIEW





NOTE:
ALL DIMENSIONS ARE IN MM (IN.)

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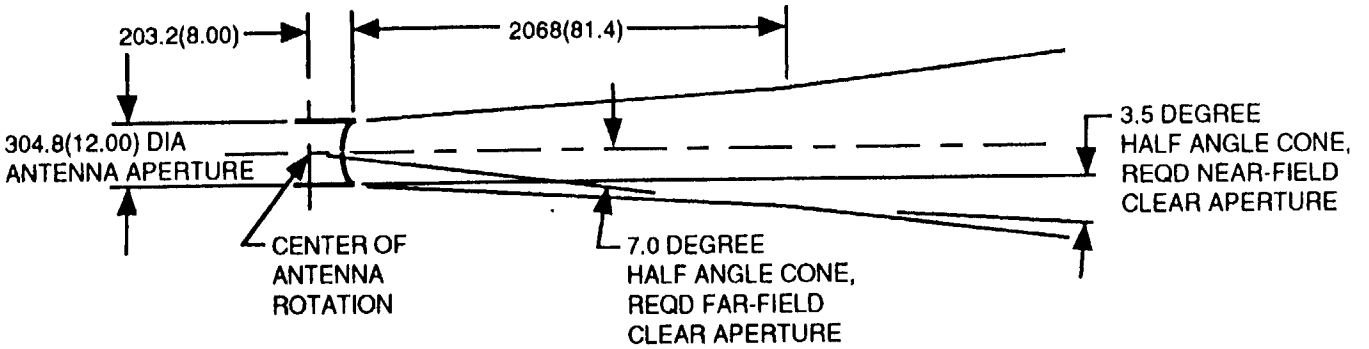
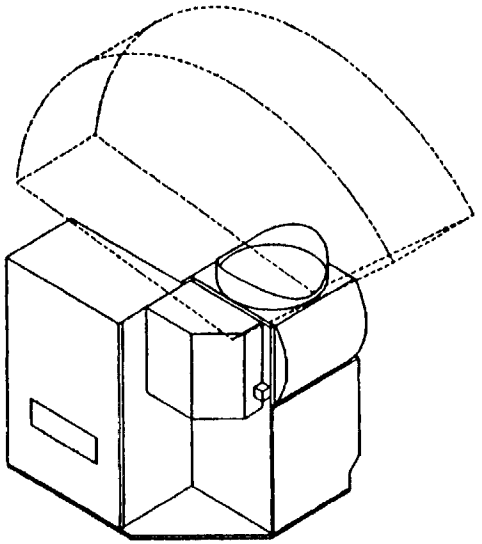
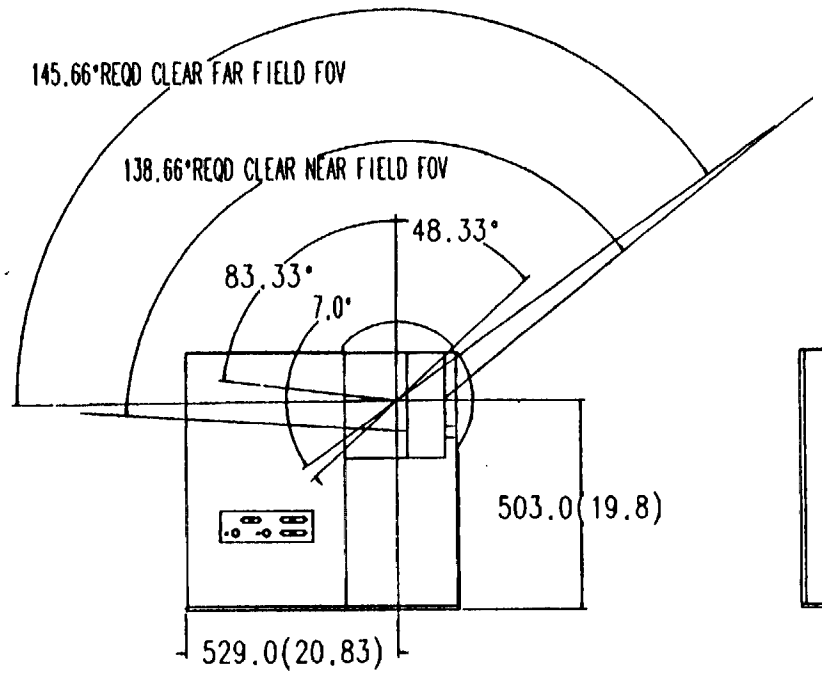
Recommended Considerations for the AMSU-A2 Field-of-View Allocation - Figure 4 of UIID

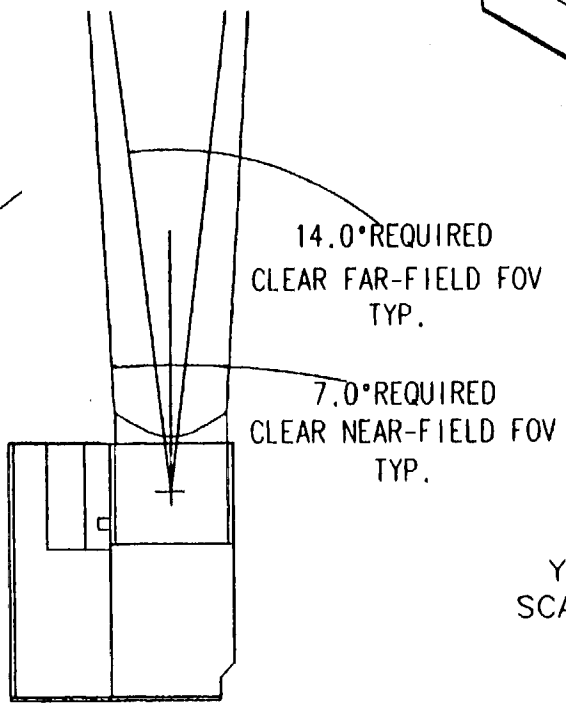
NASA

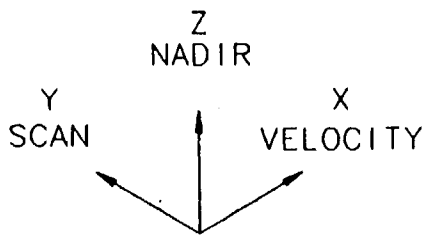




REQUIRED ANTENNA INSTANTANEOUS SOLID ANGULAR FIELD OF VIEW







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Recommended Considerations for the AMSU-A Beam-Pointing Budget Allocation

NASA

- ActionItem 2/2-1:
  Aerojet and GSFC to verify stability requirements on spacecraft and instrument.

- Overall Beam-Pointing Requirement per Aerojet Scientists:
  10 - 15 Percent of a Beamwidth, or 0.33 - 0.50 degrees

- UIID Beam-Pointing Budget is Consistent with Requirement.
  Per UIID Section 3.1.4. Pointing Allocation

	Pointing Accuracy (3σ)	Pointing Knowledge (3σ)	Pointing Stability, per Axis (3σ)
SPACECRAFT ALLOCATION Instrument Alignment Cubes to Spacecraft Navigation Reference	0.20 deg	0.10 deg	0.10 deg/s
INSTRUMENT ALLOCATION Boresight to Alignment Cube	0.20 deg	0.10 deg	0.05 deg/s
TOTAL ALLOCATION	0.28 deg	0.14 deg	0.15 deg/s

- Recommend UIID Specifically Exclude Short-Term Jitter from Instrument Beam-Pointing Stability Budget

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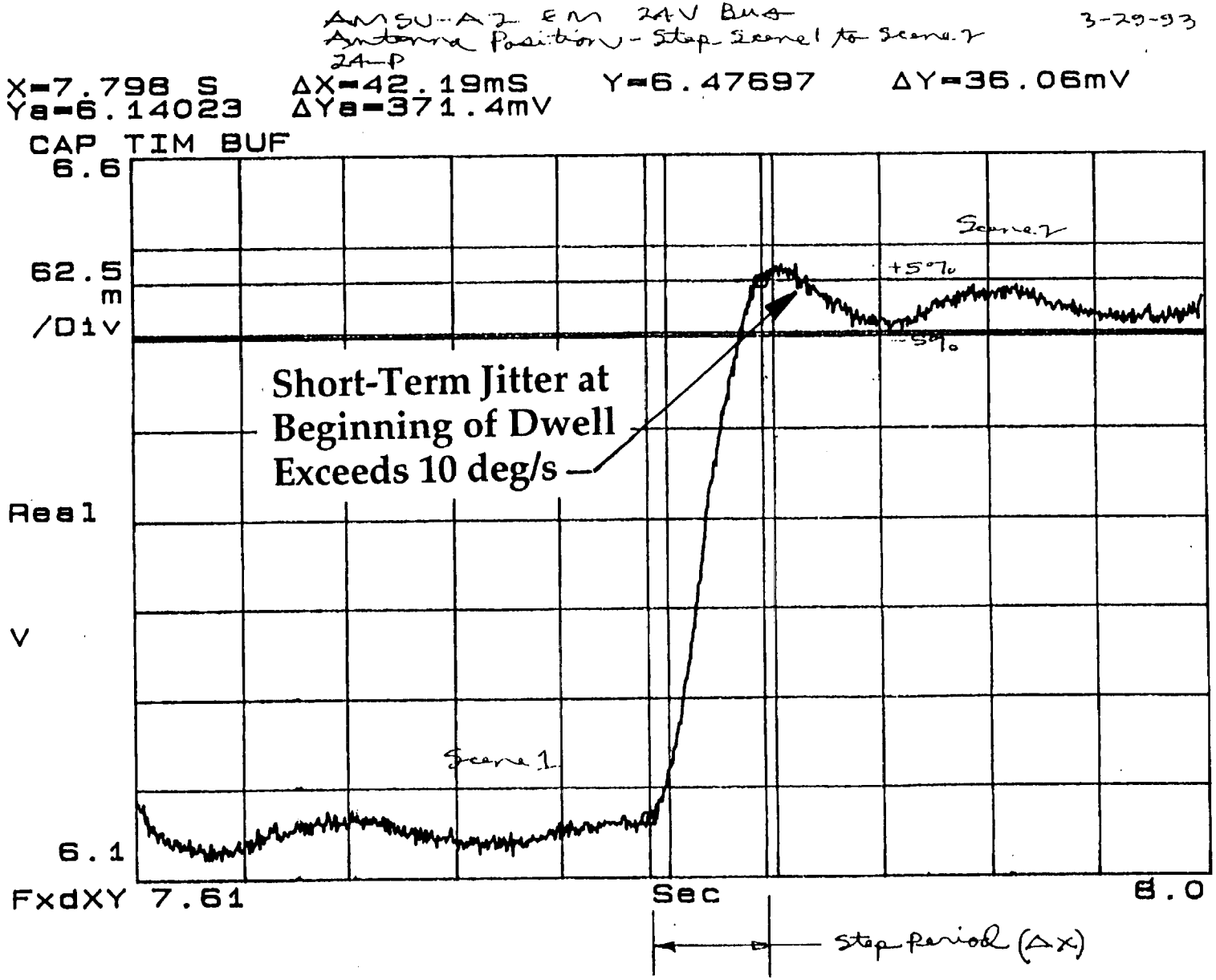
Antenna Short-Term Jitter After Position Step Exceeds Stability Requirement

NASA



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Recommended IDD Changes

NASA

- Configuration Drawings
- Access and Tagging
- Connector Locations and Access

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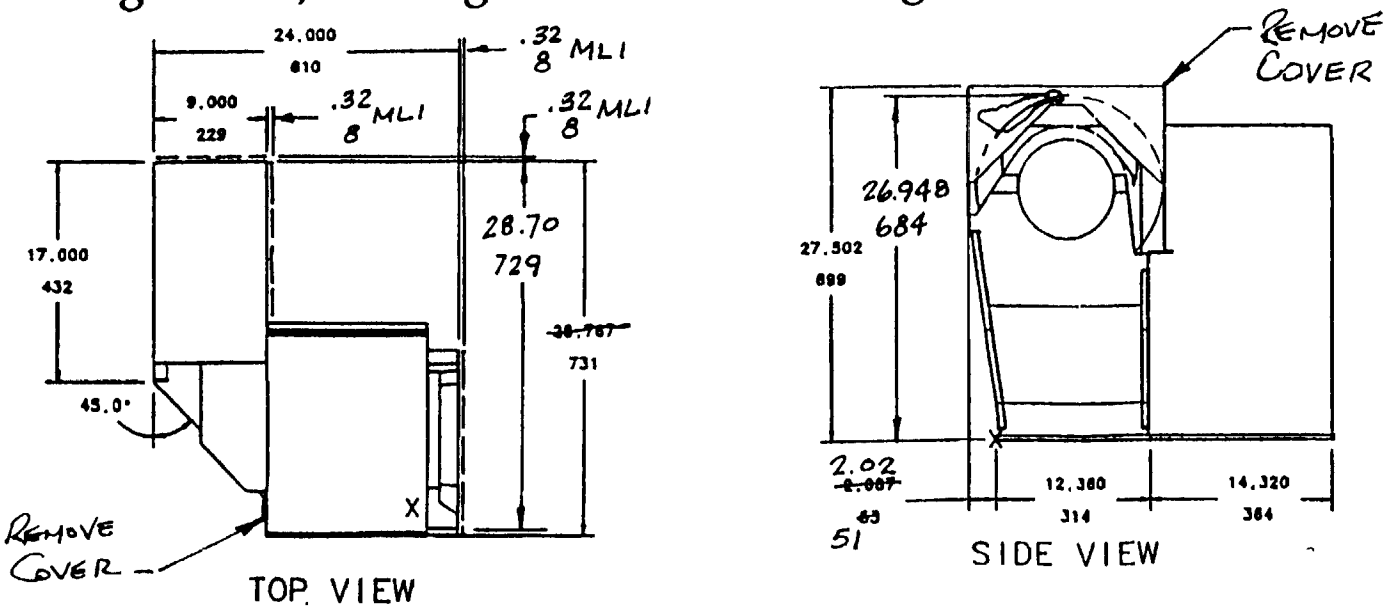
Recommended Changes to IDD Section 3.1.2 Configuration Drawings

NASA

- Delete the "Boresight" Alignment Cubes (Existing NOAA/ AMSU-A Cubes) on Both AMSU-A1 and -A2 in Figures 3.2 and 3.3
- Identify the PLLO Adjustment Access (as Previously Shown) on AMSU-A1 in Figure 3.2
- Revise AMSU-A2 Instrument Configuration Drawing, Figure 3.3, Adding MLI and Removing Cover:



- Aerojet will Provide Updated Drawings on IDEAS to Estimate Thermal Radiator, Blanket, Painted Surface, and Exposed Contamination-Source Locations per Section 3.1.2

Section 3.11 Access and Tagging; Add the Following List:

<u>Items to be Tagged for Removal</u> AMSU-A1 Antenna Covers, Qty 2 AMSU-A2 Antenna Cover, Qty 1 AMSU-A1 Feedhorn Covers (Inside Antennas), Qty 2 AMSU-A1 Feedhorn Cover (Inside Antenna), Qty 1	All Items to be in Place at All Times Except During Tests, and Tagged for Removal Prior to Launch
<u>Items to be Tagged for Installation</u> AMSU-A1 Alignment Cube Cover, Qty 1 AMSU-A2 Alignment Cube Cover, Qty 1	Items to be in Place at All Times Except During Alignment and Mounting, and Tagged for Replacement After Instrument Installation on Spacecraft

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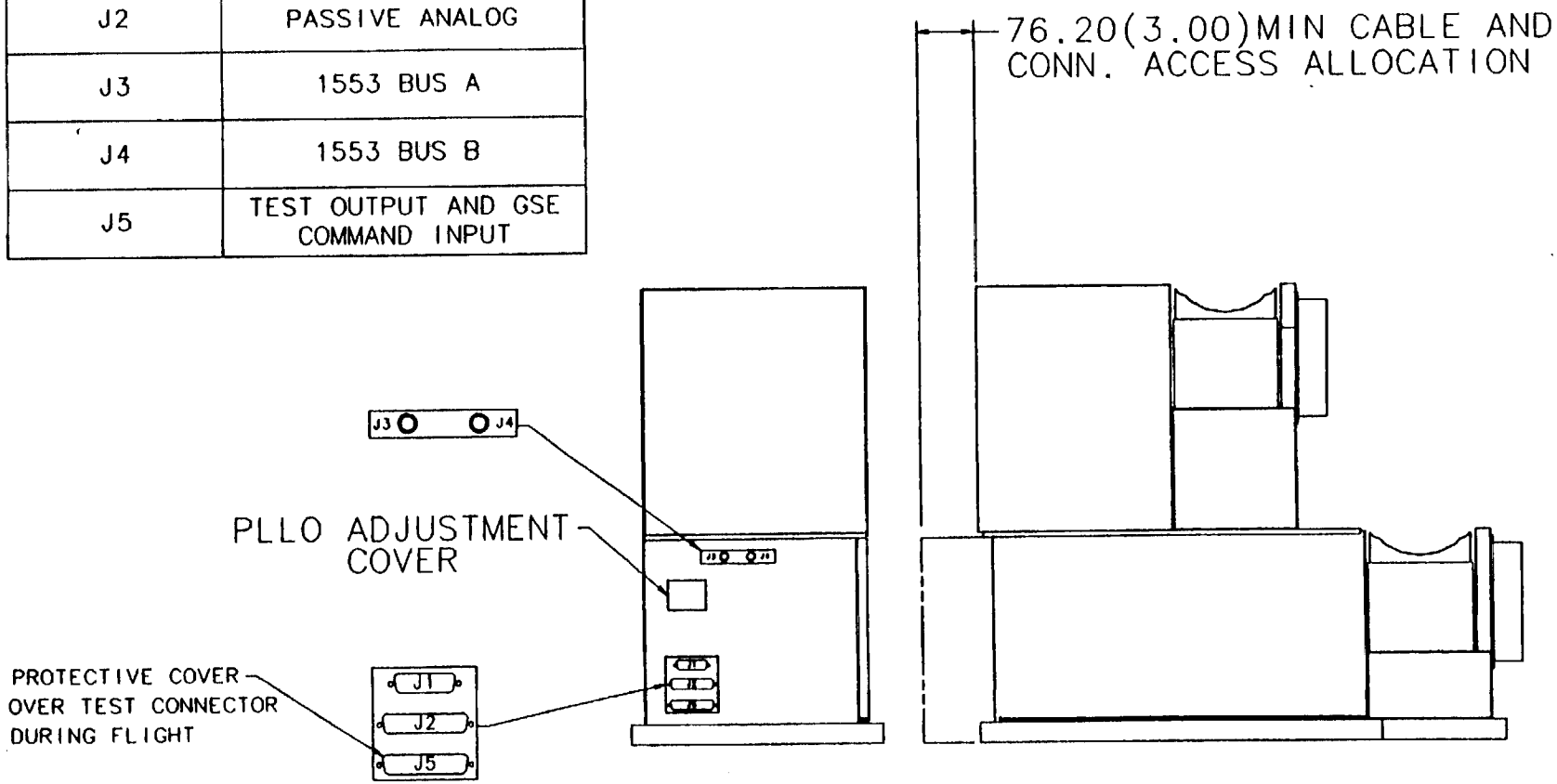
AMSU-A1 IDD Connector Location and Access Requirements

NASA

ModifyFigure 3-11 As Shown:

INTERFACE CONNECTOR DESIGNATION	CONNECTOR FUNCTION
J1	POWER INPUT
J2	PASSIVE ANALOG
J3	1553 BUS A
J4	1553 BUS B
J5	TEST OUTPUT AND GSE COMMAND INPUT



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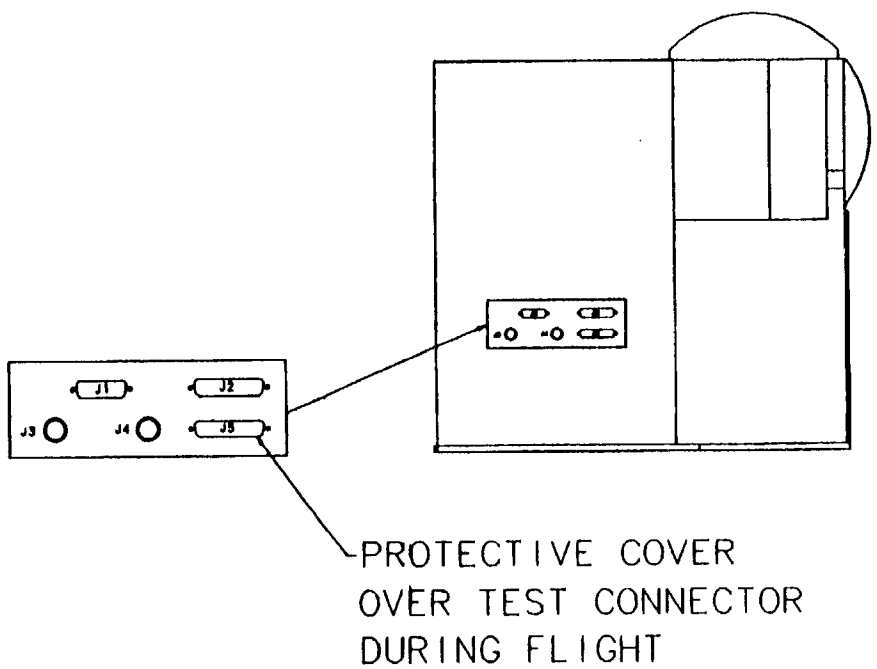
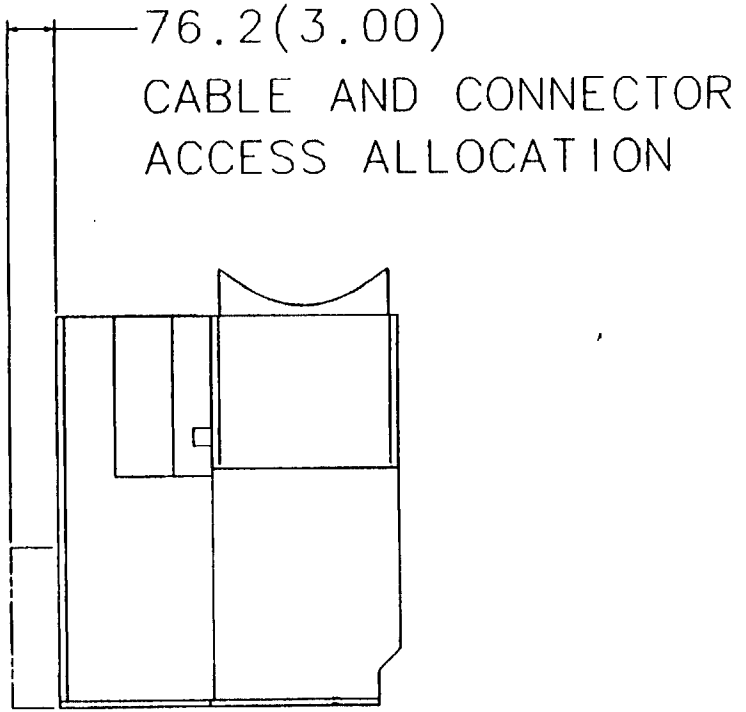
AMSU-A2 IDD Connector Location and Access Requirements

NASA

ModifyFigure 3-12 As Shown:

INTERFACE CONNECTOR DESIGNATION	CONNECTOR FUNCTION
J1	POWER INPUT
J2	PASSIVE ANALOG
J3	1553 BUS A
J4	1553 BUS B
J5	TEST OUTPUT AND GSE COMMAND INPUT





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Action Item Dispositions

NASA

Action Item Number	Description	Disposition
2/2-1	Aerojet to Investigate Placing an Alignment Cube Near the Interface	Complete; Drawings in IDD
2/2-2	Aerojet to Provide Updated IDEAS Models in UNV File Foremat	Models Provided; Updates to Continue
2/2-3	Aerojet to Verify Scan Directions, Cold-Cal Positions, and Field of View	Verified; See Following Drawing
2/2-4	Aerojet to Verify Stability Requirements on Spacecraft and Instrument	Verified; See UIID Discussion
2/2-13	Aerojet to Provide Radiometric Sensitivities	Sensitive Frequencies Provided; Also See EMI Presentation
2/2-17	Aerojet to Indicate Keep-out Zones Around Instruments for Spacecraft Mounting and Servicing	Completed; See Integration and Test Presentation

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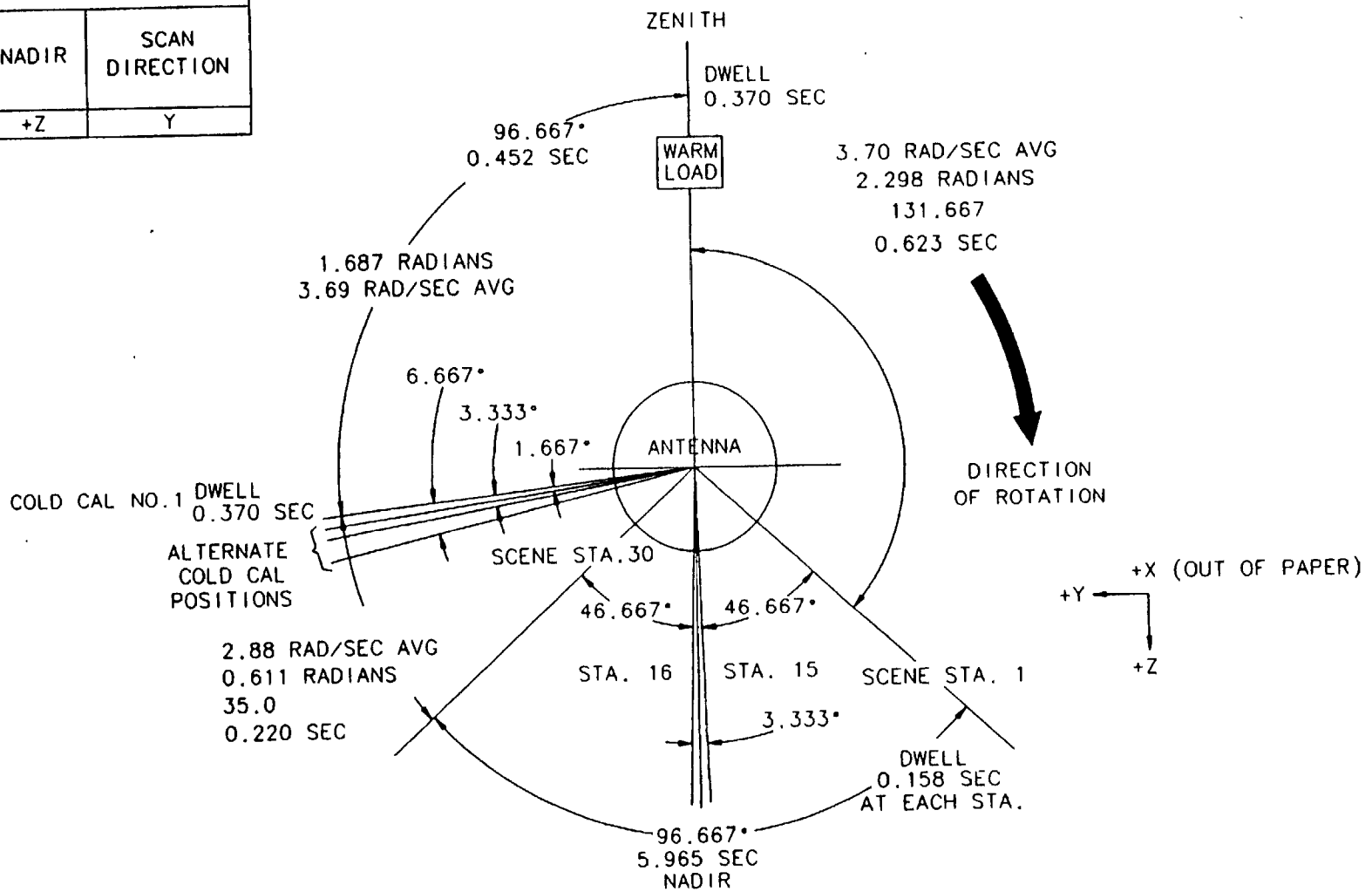
AMSU-A Scan Profile for All Antennas

NASA

EOS REFERENCE COORDINATES		
ORBITAL VELOCITY DIRECTION	NADIR	SCAN DIRECTION
+X	+Z	Y



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Agenda - Mechanical Interfaces - Wayne Ely

NASA

- Recommended Changes To UIID
- Recommended Changes To IDD
- Action Item Review

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NASA

EOS/AMSU-A
Mechanical Interfaces
Mounting, Mass Properties, Structures, Torque

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Recommended Changes To UIID NASA

- **Section 3.1.1** — Current Envelopes For A2 Unit (Figures 2 And 4) Show Non-Flight Cover Over The Primary Reflector. Recommend That The Views Be Updated To Remove Non-Flight Cover

- **Section 3.1.3** — Mass Allocation For A1 And A2 Units Would Provide Approximately Equal Margins If The Following Were Used:

	Total Instrument	110 kg
	A1	60
Recommend:	A2	50

- **Section 5 Item 1** — Deviations/Waivers
  Aerojet Requests That Disturbance Torque Limit Be Raised From 55 To 60 In-Lb. The 55 In-Lb Torque Was A Single Measurement. Some Margin Is Required To Accommodate Unit To Unit Variability

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Recommended Changes To UIID NASA

- **Section 5 Deviations/Waivers**

Add New Item:

GIRD Paragraph 3.3.3.2: Requirement To Measure Center Of Mars Deleted On Negotiations. Requirement Should Be Deleted

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Recommended Changes To IDD

NASA

- **Section 3.3.4 Moment Of Inertia And Center Of Mass**

Center Of Mass (mm)	A1	A2
X	–298	–211
Y	–159	337
Z	231	315
Moment Of Inertia (kg-m²)		
Ixx	2.0	2.6
Iyy	3.5	2.4
Izz	2.6	2.4
Products Of Inertia (kg-m²)		
Ixy	0.8	–1.2
Ixz	0.0	0.0
Iyz	0.0	0.0

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Recommended Changes To IDD

NASA

- **Section 3.4.1 Mount Approach**

  Is — **"Both.....Are Pinned Mount, With Two Pins Each..."**

  Recommend: — **"Both.... Are Hard Mounted With Two Alignment Pins Each And Multiple Bolts..."**

- **Section 3.4.2 Mounting Details**

  The A1 Hole Pattern Has Been Revised Slightly And Is Shown In The Following Chart

  Aerojet Recommends Changing Mounting Hole Diameter To Accept Metric Hardware To Maintain Spacecraft Consistancy. Both A1 And A2 Hole Diameter Would Be 6 mm (Thru Thermal Isolator)

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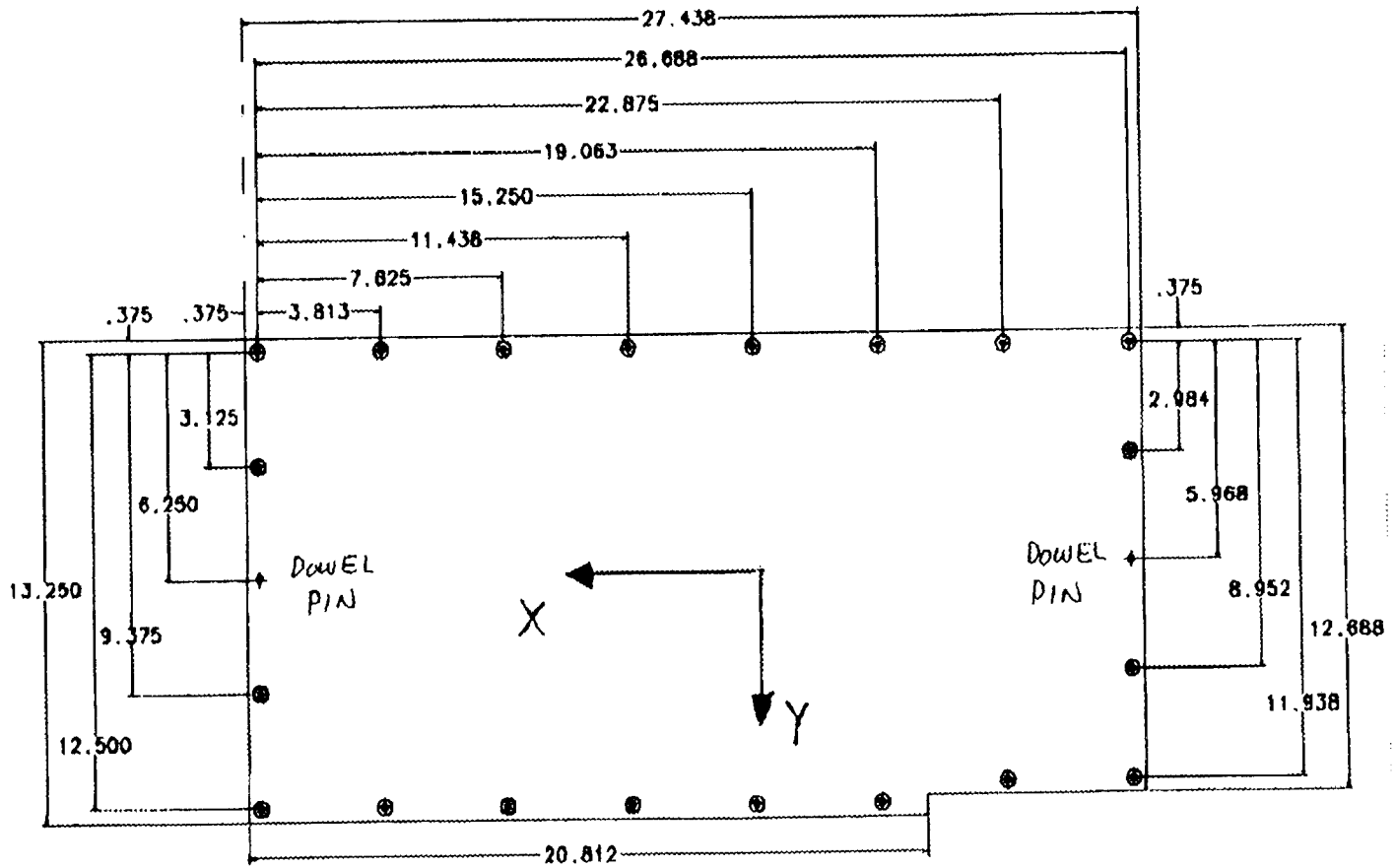
Revised A1 Mounting Hole Pattern

NASA



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Recommended Changes To IDD

NASA

- **Section 3.4.2 Mounting Details**

  Add The Following Information:
  The Crushing Strength Of The Thermal Isolators At The Interface Limits The Bolt Preload To 2150 Lbs. This Is Equivalent To Approximately 80 In-Lbs Of Installation Torque

- **Section 3.6.2 Fixed Base Frequency**

  "The First Mode Of Both Units Will Be Greater Than 100 HZ"

  The NOAA/AMSU A2 Unit Currently Has A Fundamental Frequency Of 81 HZ. EOS/A2 Unit Will Be Stiffened To Drive Frequency Above 100 Hz, Avoiding Tests And Analyses

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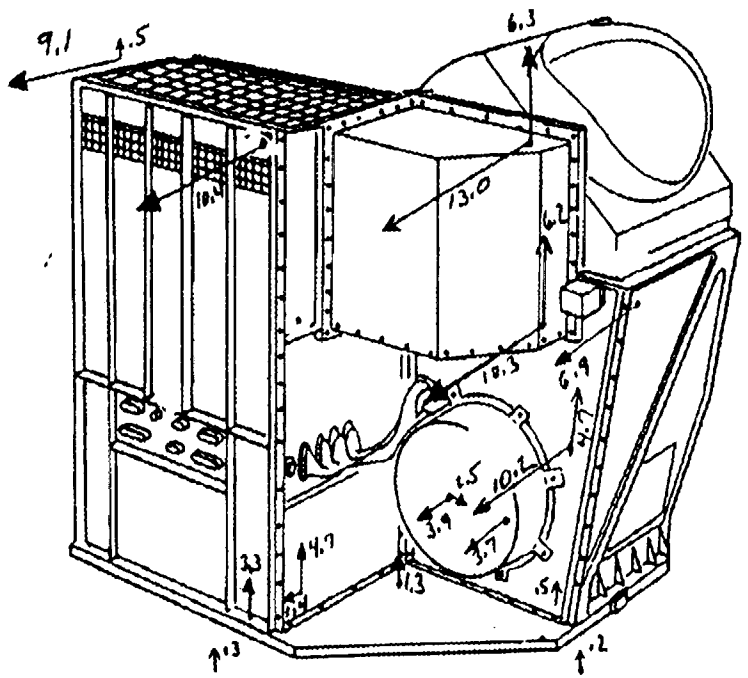
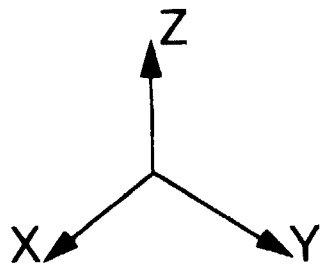
A2 Vibration Mode

NASA





Amplification Factors @ 81 Hz, X-Axis Input

Recommend No Change To IDD

GENCORP AEROJET

Additional IDD Comments

NASA

- **Section 3.7** **Simplified Finite Element Model**

  Aerojet Reviewed The Models In Early March

  Comments Were Submitted To NASA

  Review Of IDD Shows Comments Have Been Incorporated Into The Simplified Models

GENCORP AEROJET

Recommended Changes To IDD

NASA

- **Section 3.10 Disturbances**

Unit	Uncompensated Momentum (N-M-Sec)
A1	.02
A2	.16
Specification Limit	.5

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Action Item Review

NASA

Action Item No.	Action Item Statement	Response
2/2-15	Aerojet To Verify Torque vs Preload For Mounting Bolts	Torque Limit Is 80 In-Lbs This Produces Preload Of 2150 Lbs (See 3.4.2, IDD)
2/2-18B	Aerojet To Analyze If Kinematic Mount Is Needed Based On Memo	Preliminary Analysis Shows That Thermal Stresses Are Acceptable. Analysis Will Be Repeated Using Finite Element Models
2.2-18C	Aerojet To Review Finite Element Models	Review Completed And Comments Forwarded On 3/15/93. (See 3.7, IDD)

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Action Item Review

NASA

Action Item No.	Action Item Statement	Response
2/2-19	NASA To Consider Waiver Of 50 In-Lb Limit On Torque. Aerojet To Provide Recommended Value	Aerojet Recommends A Disturbance Torque Limit Of 60 In-Lbs (See 5.0, UIID)
2/2-24	Revise Moment Of Inertia Units To $Kg\text{-}M^2$	Units Have Been Changed (See 3.3.4 IDD)

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NASA

EOS/AMSU-A1/A2 Thermal Interface

GENCORP AEROJET

Agenda - Thermal - Bob Krylo

NASA

- UIID Review
- IDD Review
- GIRD Sun Angle
- Action Items

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UIID Review - Thermal

NASA

- Section 3.2 Thermal Control Power Allocations:
  - Appropriate
- Section 5.0 Deviations/Waivers
  - Item 2. "Heat Transfer To Spacecraft For A1 Exceeds 15.5 Watts Per Square Meter (W/m^2) (GIRD Paragraph 4.3.1) / Heat Transfer From A1 To Spacecraft Is Approximately 17.5 W/m^2 "
  - Concern: A1 Transfers 5W Over 0.234 m^2, 21.3 W/m^2
  - Recommendation: Increase Allocation To 25.0 W/m^2 Per Module

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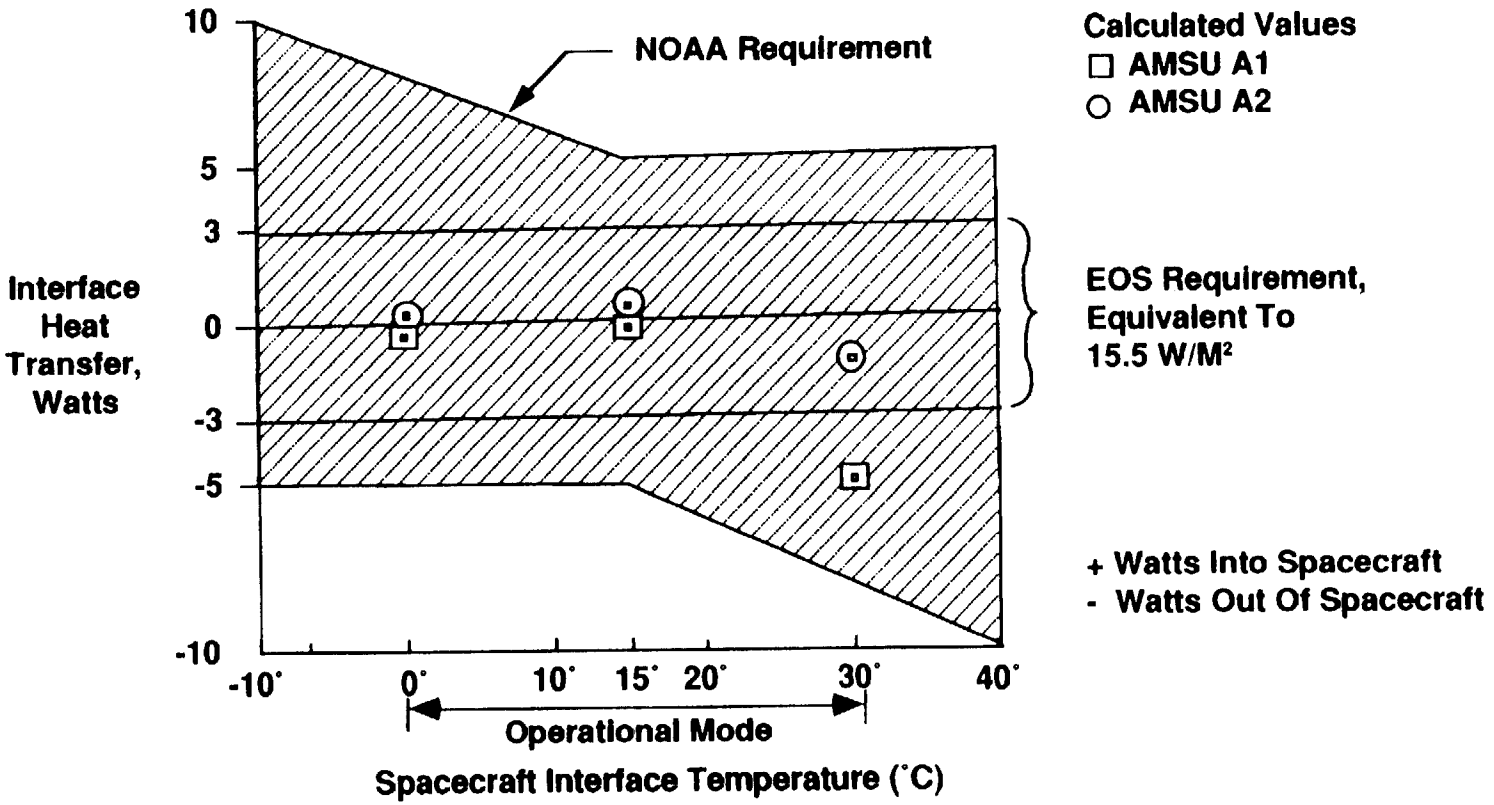
Tailoring Of EOS Interface Heat Transfer Requirement Is Recommended

NASA



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UIID Review - Thermal (cont)

NASA

- **Section 5.0 Deviations/Waivers**
  - **Item 3. Survival Power Exceeds 30% Limit By 3% (GIRD Paragraph 4.6.1.3) / Allocation Is 33%**
  - **Concern: The A1 And A2 Modules Combined Use 41%**

	A1	A2
Operating	74W	26W
Survival (Avg)	36W	5W

  - **Recommendation: Increase Allocation To 50% For The Combined Modules**

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Recommended Changes To IDD - Thermal

NASA

- See Marked Up Pages For Details

4. THERMAL DESIGN

4.1 THERMAL CONTROL PHILOSOPHY:

The AMSU-A instrument consists of three microwave antenna units housed within two separate enclosures. Thermal control of each unit (A-1 and A-2) is independent of the other. During normal operating mode, the A-1 and A-2 modules use passive radiators to reject their heat to space. ~~Only the warm load relies upon active heater control.~~ Internal heaters are only used as required to supply make-up heat during survival mode. Internal power dissipation sources are identified in figures 3-13 & 3-14.

4.2 REQUIREMENTS

4.2.1 TEMPERATURES

COMPONENT	WHERE TEMP. REQT APPLIES	ALLOW. TEMP. RANGE (MIN/MAX, °C)		
		OPERATING	SAFE [5]	SURVIVAL
All ~~internal~~ components, ~~except warm loads~~	COMPONENT TEMP. SENSOR	+8 / +28 [1,2]	-30/+50	-30 -20 / +50
A1 Warm Load	WARM LOAD TEMP. SENSORS	0 / +20 [3]	-30/+50	-30/+50
A2 Warm Load	WARM LOAD TEMP. SENSORS	+10 / +30 [3]	-30/+50	-30/+50

Notes:

1. Max. variation of any component over all orbits during operation = ± 10 °C.
2. Max. rate of change of temperature of components (feedhorn to detector/pre-amp) <0.002 °C /sec.
3. Max. rate of change of warm load temperatures <0.005°C /sec.
4. SEE PARA. 4.2.2.1
5. Safe mode is antenna drive off, all other systems on.

RADIATORS [4]

4.2.2 ELEMENTS OF THE THERMAL CONTROL SYSTEM

4.2.2.1 RADIATORS

RADIATOR LOCATION & DESCRIPTION	SURFACE NORMAL	POWER. DISSIPATION (W)			AREA (M^2)	SURF. MAT'L	ALLOWABLE TEMPERATURE RANGE (MIN/MAX, °C)		
		Operate	Safe	Survival			Operating	Safe	Survival
A1-upper side	+Y	74	58	36	TBD	SSM*	-30/+50	-30/+50	-30/+50
A1-lower side	+Y				TBD	SSM*	-30/+50	-30/+50	-30/+50
A1-upper rear	+X				TBD	SSM*	-30/+50	-30/+50	-30/+50
A1- lower rear	+X				TBD	SSM*	-30/+50	-30/+50	-30/+50
A1- top surface	+Z				TBD	SSM*	-30/+50	-30/+50	-30/+50
A2- side radiator	-X	26	12	5	.118	Silver Teflon	-30/+50	-30/+50	-30/+50
A2- side radiator	+X				.106	Silver Teflon	-30/+50	-30/+50	-30/+50

*Second -surface mirrors

4.2.2.2 PROVISION FOR COLDPLATES (not applicable)

4.2.2.3 BLANKETS

BLANKET LOCATION	NUMBER OF LAYERS	OUTER LAYER MAT'L
Most All non-radiating surfaces on both A1 & A2	~~20~~ 21	Aluminized Mylar

4.2.2.4 APERTURES/COVERS (NONE)

APERTURE LOCATION	COVER? (Y/N)	SIZE (M^2)	COVER OUTER LAYER MAT'L	COVER STATUS (OPN/CLS)		
				OP.	SAFE	SURV.
A1 - Upper Antenna	N	N/A	N/A	N/A	N/A	N/A
A1 - Lower Antenna	N	N/A	N/A	N/A	N/A	N/A
A2 - Antenna	N	N/A	N/A	N/A	N/A	N/A

4.2.2.5 HEATERS

HTR LOC.[1]	PWR DISS. (W)	CONTROL TYPE (PROP., ON/OFF, etc.)	USE MODE			SET PTS (ON/OFF) (°C)	CONTROL SENSOR LOC.[1]
			OP	SAFE	SURV		
A1	26	~~Proportional~~ ON/OFF			√	-18 / -1	A1-1 RF SHELF
A1	18	~~Proportional~~ ON/OFF			√	-18 / -1	A1-2 RF SHELF
A2	14	~~Proportional~~ ON/OFF			√	-18 / -1	RF SHELF

Note 1: Refer to configuration drawing of section 3.1.2.

4.2.2.6 LOUVERS

None

4.2.2.7 FLIGHT TEMPERATURE SENSORS
See ~~figures 3-15 & 3-16~~ & tables ____ and ____.

4.2.2.8 OTHER ELEMENTS

4.2.3 OTHER ASPECTS OF THERMAL DESIGN

4.2.3.1 PARASITIC HEAT TRANSFER TO / FROM SPACECRAFT

4.2.3.1.1 CONDUCTIVE PATHS
The AMSU-A instrument is conductively isolated from the spacecraft via insulating mounts. Analytical predictions indicate that the total of conductive and radiative heat transfer to/from the spacecraft may exceed the requirements listed in the GIRD by approximately 5 watts during hot case (operating).

4.2.3.1.2 RADIATIVE PATHS

4.2.4 THERMAL MODELS :
Refer to Reduced Thermal Models (RTMs) AS1-THP2.INP and AS1-SHP2.INP for AMSU-A1; AS2-THP1.INP and AS2-SHP1.INP for AMSU-A2 transmitted with this document. The schedule for delivery of the detailed thermal model will be established in accordance with requirements listed in the GIRD document.

4.2.5 THERMAL GSE None

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IDD Paragraph 4.2.2.7 Flight Temperature Sensors, 1 of 2

NASA

A1 Sensor Locations, Thermal			
Assigned Numbers	Description Of Part Installed On	Assembly Used On	Allowable Range, °C
RT 1 Thru RT 5	A1-1 Warmload	1331381	0/+20
RT 6 Thru RT 10	A1-2 Warmload	1331381	0/+20
RT 11	G.D.O. Channel 7	1331525	+8/+28
RT 12	G.D.O. Channel 8	1331455	+8/+28
RT 13	G.D.O. Channel 15	1331525	+8/+28
RT 14	PLL L.O. Channel 9/14	1331525	+8/+28
RT 15	PLL L.O. Channel 9/14	1331525	+8/+28
RT 16	Crystal Oscillator	1331525	+8/+28
RT 17	Mixer/IF Amplifier Ch-3	1331455	+8/+28
RT 18	Mixer/IF Amplifier Ch-4	1331455	+8/+28
RT 19	Mixer/IF Amplifier Ch-5	1331455	+8/+28
RT 20	Mixer/IF Amplifier Ch-6	1331525	+8/+28
RT 21	Mixer/IF Amplifier Ch-7	1331525	+8/+28
RT 22	Mixer/IF Amplifier Ch-8	1331455	+8/+28
RT 23	Mixer/IF Amplifier Ch-9/14	1331525	+8/+28
RT 24	Mixer/IF Amplifier Ch-15	1331525	+8/+28
RT 25	IF Amplifier Ch 11/14	1331525	+8/+28
RT 26	IF Amplifier Ch 9	1331525	+8/+28
RT 27	IF Amplifier Ch 10	1331525	+8/+28
RT 28	IF Amplifier Ch 11	1331525	+8/+28
RT 29	IF Amplifier Ch 12	1331525	+8/+28
RT 30	IF Amplifier Ch 13	1331525	+8/+28
RT 31	IF Amplifier Ch 14	1331525	+8/+28
RT 32	DC/DC Converter	1331720	+16/+36
RT 33	A1-A2 RF Shelf	1331455	+8/+28
RT 34	A1-A2 RF Shelf	1331525	+8/+28
RT 35	Detector/Preamplifier	1331610	+8/+28
RT 36	A1-1 Scan Motor	1331640	-30/+30
RT 37	A1-2 Scan Motor	1331640	-30/+30
RT 38	A1-1 Feedhorn	1331525	+8/+28
RT 39	A1-2 Feedhorn	1331455	+8/+28
RT 40	A1-1 RF MUX	1331525	+8/+28
RT 41	A1-2 RF MUS	1331455	+8/+28
RT 42	G.D.O. Channel 3	1331455	+8/+28
RT 43	G.D.O. Channel 4	1331455	+8/+28
RT 44	G.D.O. Channel 5	1331455	+8/+28
RT 45	G.D.O. Channel 6	1331525	+8/+28

See IDD Figure 3-15 For Survival Temperature Sensors

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IDD Paragraph 4.2.2.7 Flight Temperature Sensors, 2 of 2

NASA

A2 Sensor Locations, Thermal			
Assigned Numbers	Description Of Part Installed On	Assembly Used On	Allowable Range, °C
RT 1 Thru RT 7	Warmload	1331236	+10/+30
RT 9	Scan Motor	1333650	-30/+30
RT 10	Not Used	—	—
RT 11	Feedhorn	1331200	+8/+28
RT 12	Diplexer	1331052	+8/+28
RT 13	Mixer/Amplifier IF	1331052	+8/+28
RT 14	Mixer/Amplifier IF	1331052	+8/+28
RT 15	Secondary Reflector	1331200	+8/+28
RT 16	DC/DC Converter	1331200	+16/+36
RT 17	RF Shelf	1331052	+8/+28
RT 18	Detector Preamp Assembly	1331300	+8/+28
RT 19	Gunn Diode Oscillator	1331052	+8/+28
RT 20	Gunn Diode Oscillator	1331052	+8/+28

See IDD Figure 3-16 For Survival Temperature Sensors

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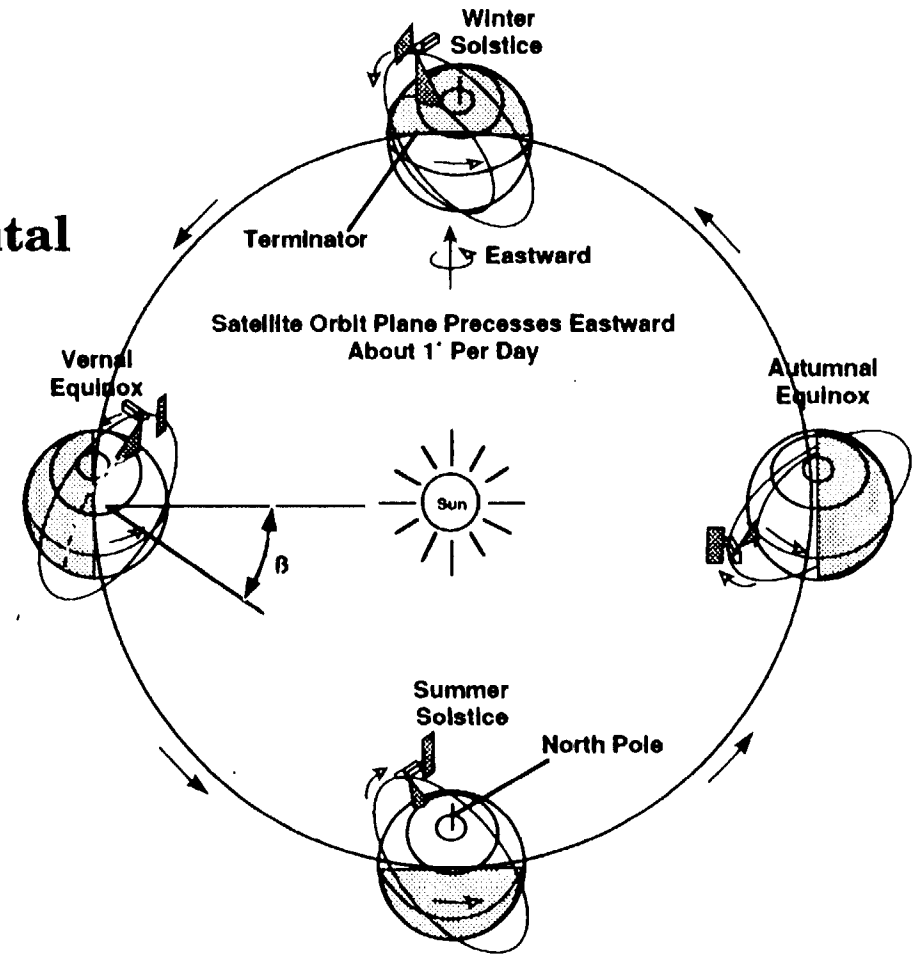
Recommended Changes To GIRD - Thermal

NASA

- **Add:**
  - **Sun Angle, ß, Is The Angle Between The Normal To The Orbital Plane And The Earth-To-Sun Line**
  - **Sun Angle Range Is 12°To 32°**



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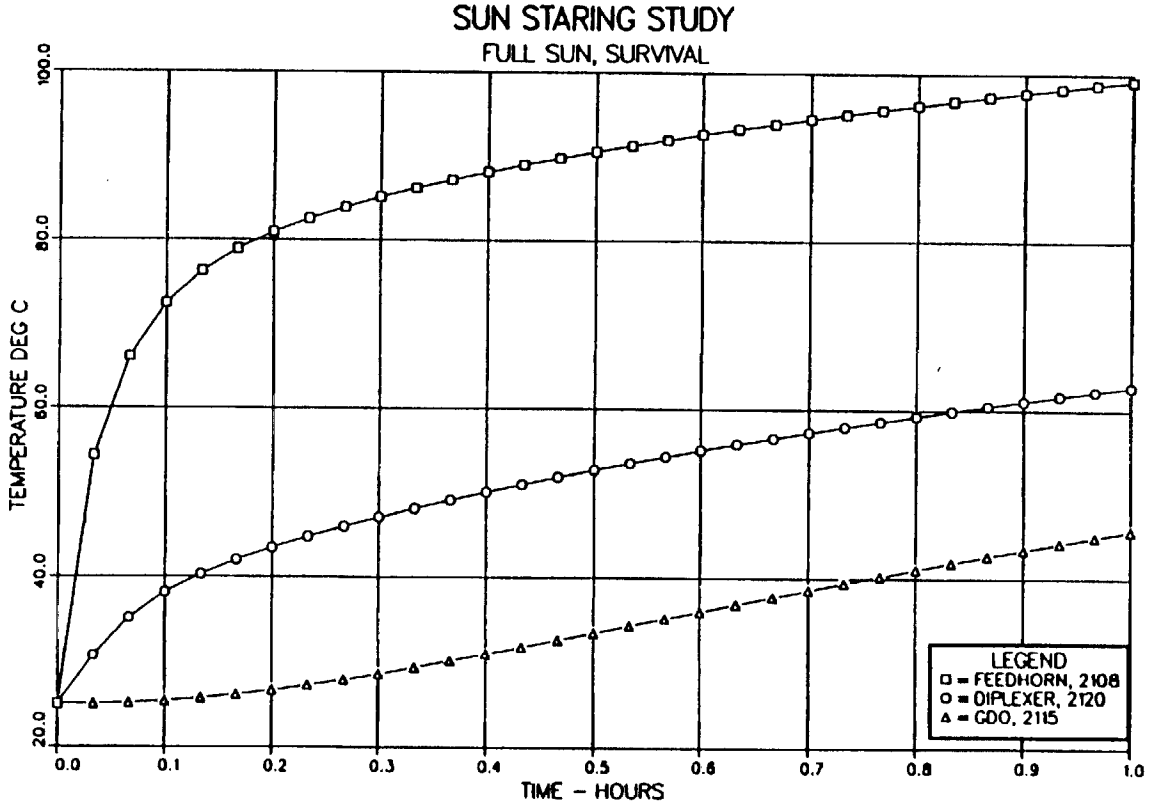
Action Item 2/2-12, How Long May The Sun Shine On The Aperture?

NASA

- **Worst Case Assumptions: Survival Mode. Full Sun Directly On The Antenna/Feedhorn**



- **Conclusions: A2 Transient Solution Shows 1 Hour Can Be Tolerated**
  Actual Survival Time Should Be Much Greater

GENCORP AEROJET

Action Item 2/2-18C, Aerojet To Review EOS Reduced Thermal Models

NASA

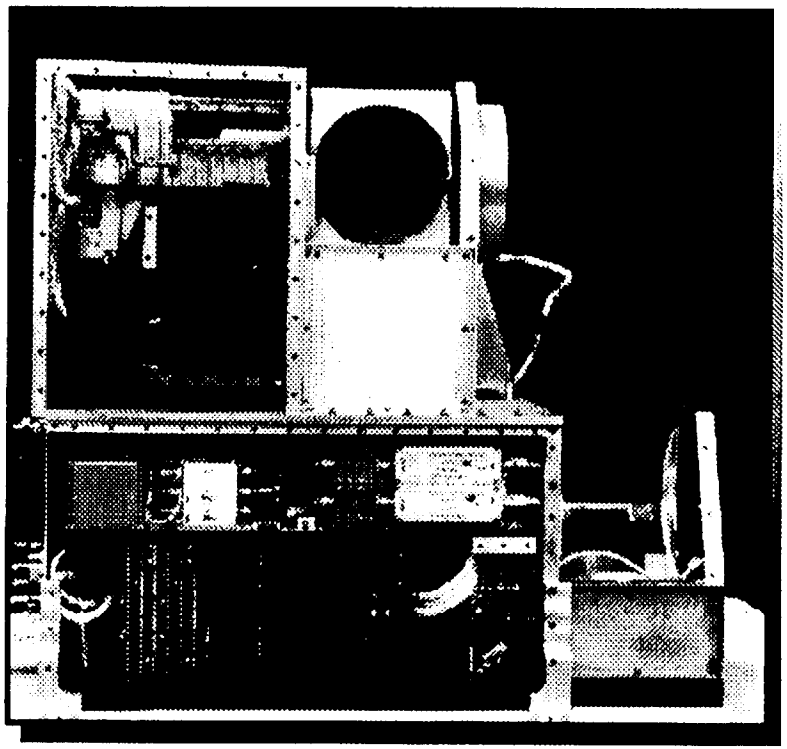
- **NASA's EOS/AMSU Reduced Thermal Models Are Correct**
- **Corrections To Aerojet's Input For A1 MLI Σ^* And A1 Survival Heater Power Have Been Submitted [1]**

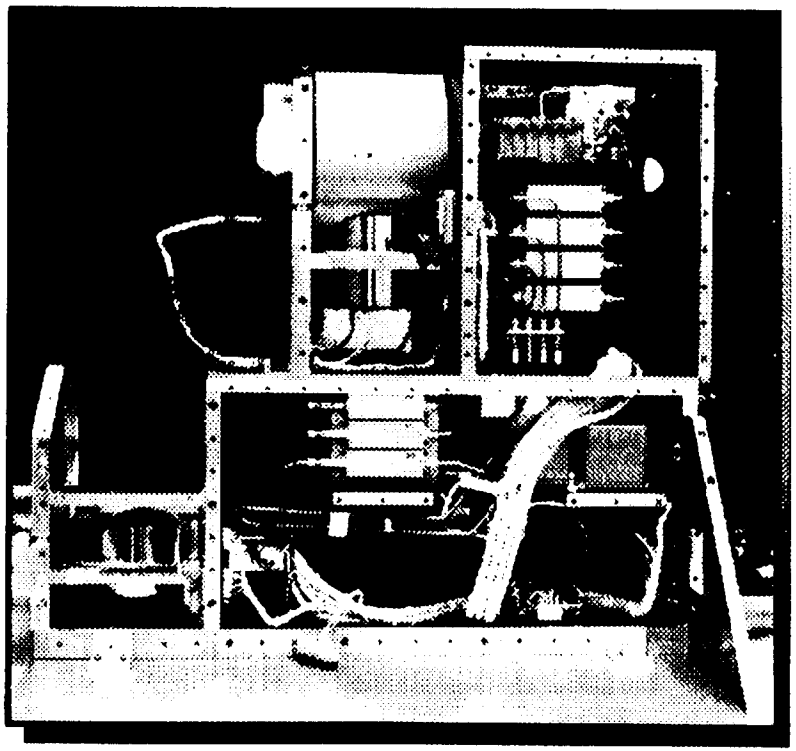
1. **See Text Of 11 March 93 Memo For Details**

GENCORP AEROJET

A Modularized Structural/Packaging Configuration Is Used For AMSU-A1

NASA





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NASA

EOS/AMSU-A Electrical, Command & Data Handling

GENCORP AEROJET

Agenda - Electrical, Command & Data Handling - M. Mark Pluck

NASA

- UIID Changes
- IDD Inputs/Changes
  - Electrical Interface Requirements
  - Command And Data Handling Requirements
- Summary

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Recommended Changes To UIID

NASA

3.3.1 Power Allocations

	Launch Mode	Survival Mode	Standby Mode	(2 Orbit Avg) Operational Mode	Safe Mode
A1	0 Watts	36 Watts	64 Watts	88 Watts	64 Watts
A2	0 Watts	5 Watts	26 Watts	37 Watts	26 Watts
Total	0 Watts	41 Watts	90 Watts	125 Watts	90 Watts

Change To:

	Launch Mode	Survival Mode	Standby Mode	(2 Orbit Avg) Operational Mode	Safe Mode
A1	0 Watts	36 Watts	68 Watts	88 Watts	68 Watts
A2	0 Watts	5 Watts	22 Watts	37 Watts	22 Watts
Total	0 Watts	41 Watts	90 Watts	125 Watts	90 Watts

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NASA

IDD Inputs/Changes Electrical Interface Requirements

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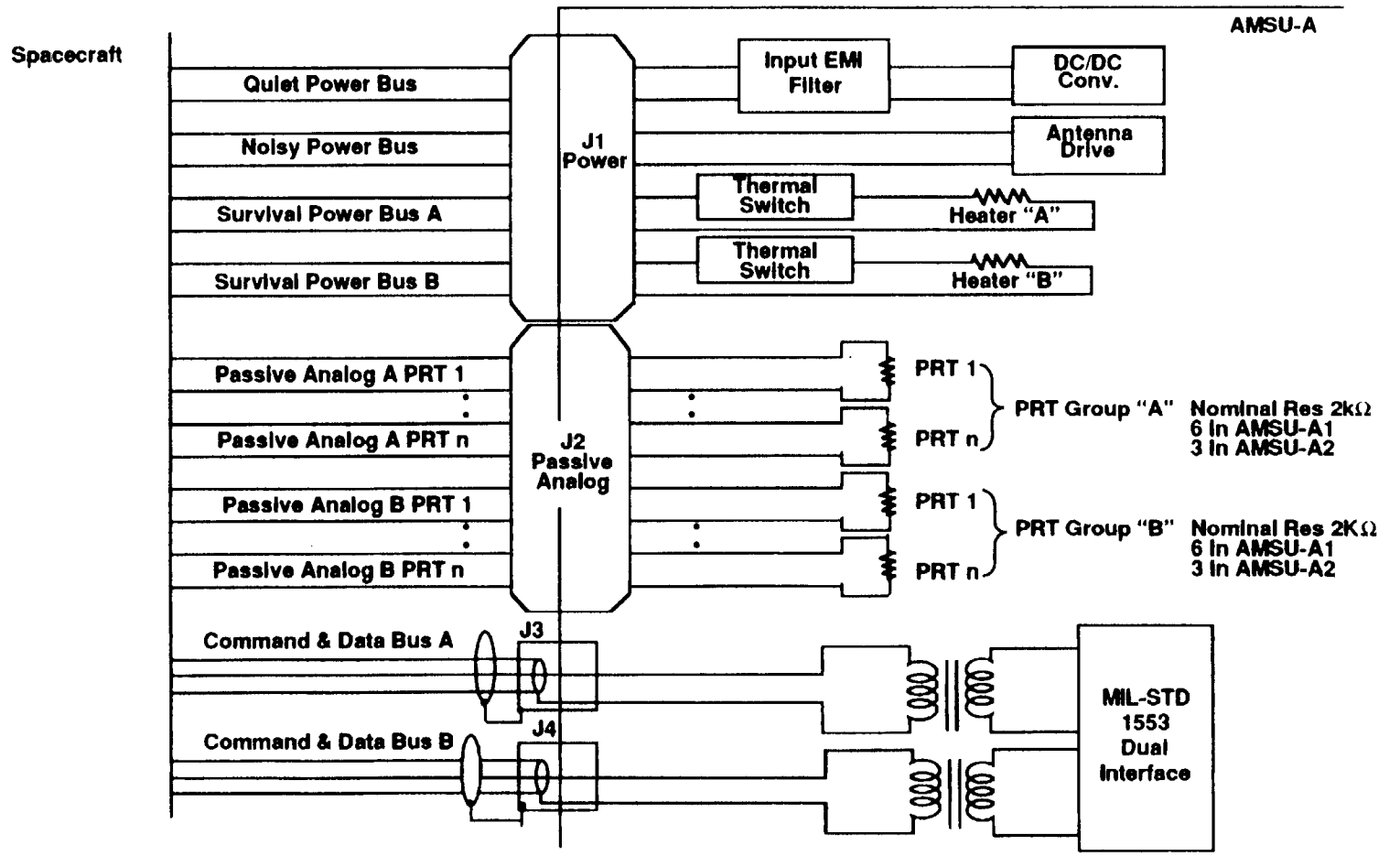
Recommended Changes To IDD

NASA

Addition To 5.1 Electrical Interface Diagram



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Recommended Changes To IDD

NASA

5.2.2 Power Profiles

	Survival Watts		Safe Watts		Operational Watts		Standby Watts	
Operating Power Per Instrument	A1	A2	A1	A2	A1	A2	A1	A2
	36	5	58	12	74	26	58	12
Total	41		70		100		70	

Change To:

	Survival Watts		Safe Watts		Operational Watts		Standby Watts	
Operation Power Per Instrument	A1	A2	A1	A2	A1	A2	A1	A2
	36	5	66	21	74	26	66	21
Total	41		87		100		87	

Recommended Additions To IDD

5.2.3. Electrical Interface Bus (Connections To Each Bus)

	A1 Watts	A2 Watts	Total Watts
Noisy Bus	7	5	12
Quiet Bus	67	21	88
Survival Bus	36	5	41

5.2.4. Over Current Protection

The Following Are Worst Case Continuous Currents For Fuze Sizing

	A1 Amps	A2 Amps
Noisy Bus	0.28 Av. 1.0 Peak	0.18 Av. 1.0 Peak
Quiet Bus	2.8	0.88
Survival Bus	1.6	0.22

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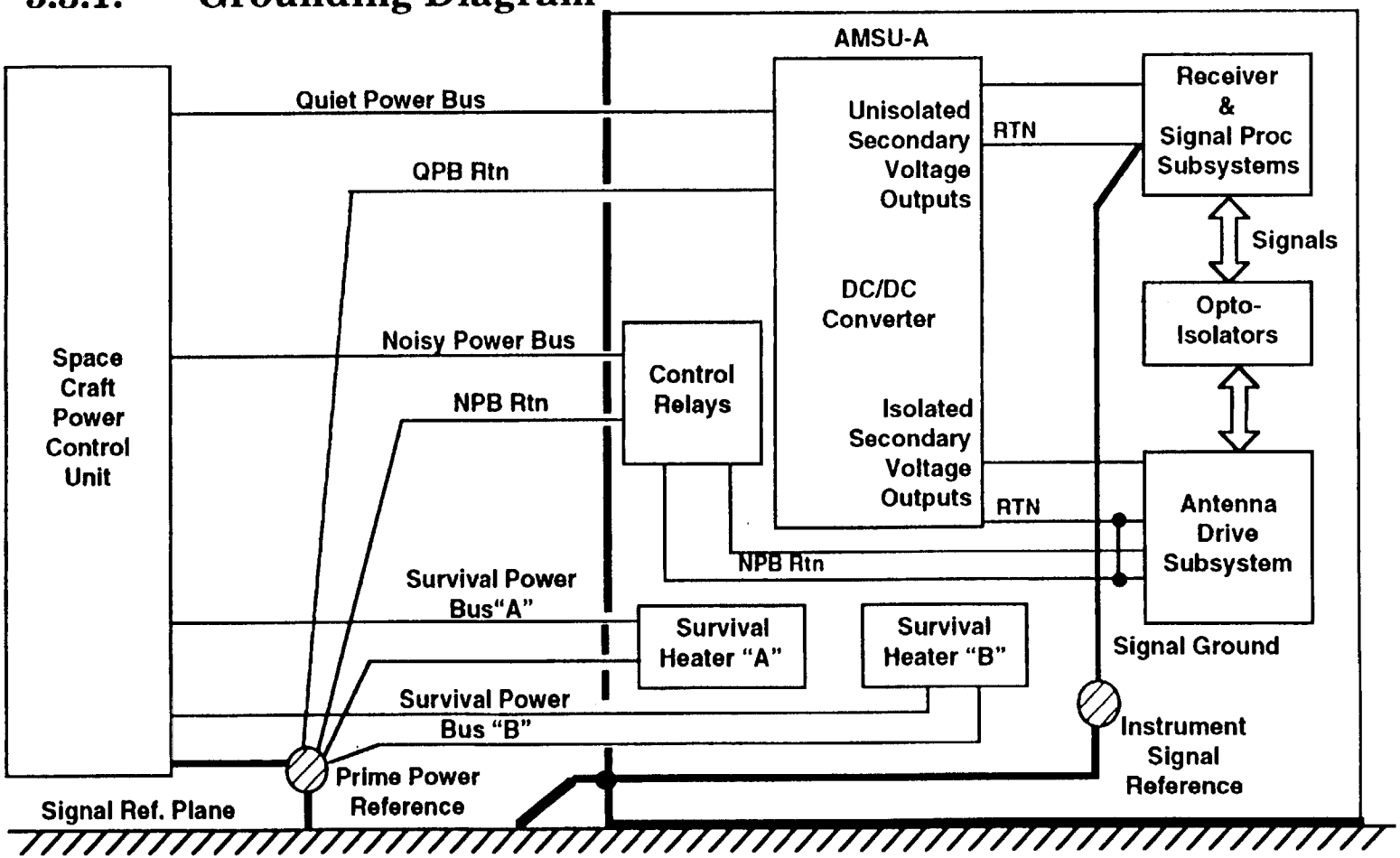
Recommended Addition To IDD NASA

5.3.1. Grounding Diagram



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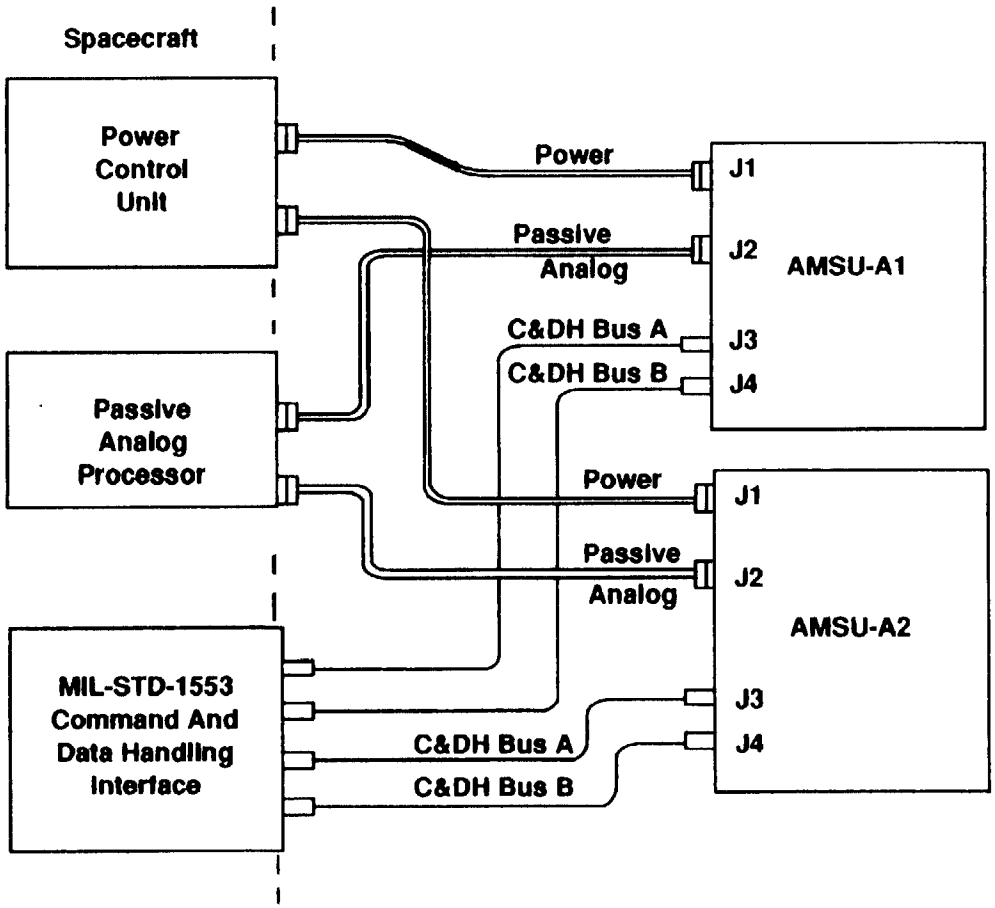
5.4.4. Cabling Diagram



GENCORP AEROJET

Recommended Addition To IDD NASA

5.4.5. Interface Connector Location And Type

Each Of The Two AMSU-A Modules Will Be Using Four (4) Connectors For The Interface To The Spacecraft

GENCORP AEROJET

Recommended Change To IDD

NASA

5.6 Test Points

Change To Read:

5.6.1. Test Point Location

All Test Points Are Brought Out Through One Test Connector (J5) On Each AMSU-A Module. Refer To Paragraph 5.4.8. For Location Of J5 On The Instrument Modules

5.6.2. Test Point Type

Recommend Deletion Due To Redundancy

GENCORP AEROJET

Action Item Review

NASA

Action Item No.	Description	Disposition Date
No. 2/2 - 11	Aerojet To Revise Passive Analog Temperature Monitoring Circuit	3/15/93

Revised Monitoring Circuit Shown In Fig. 5.1

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NASA

IDD Inputs/Changes Command And Data Handling Requirements

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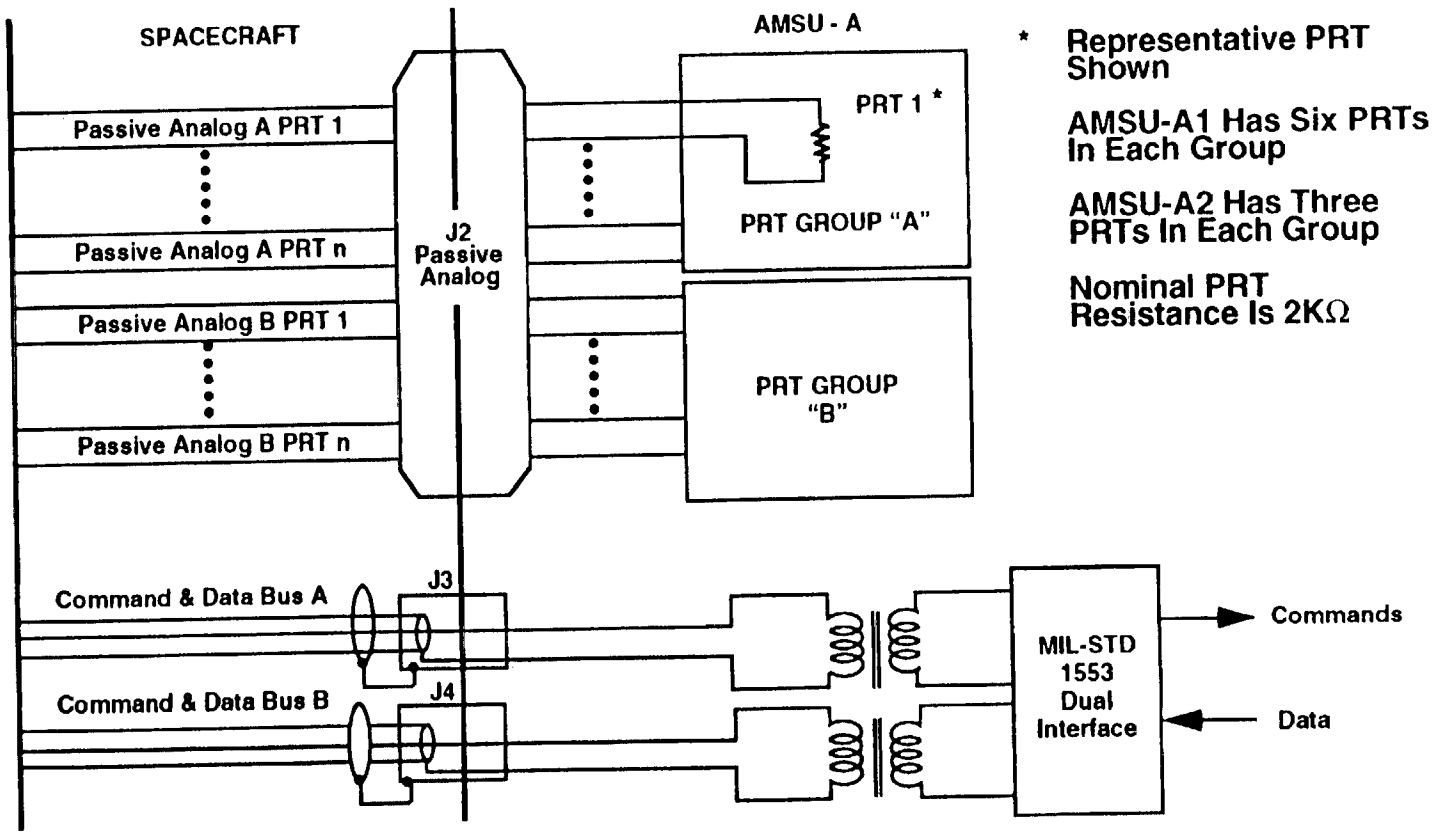
Recommended Addition To IDD NASA

Fig. 6.1 Command And Data Handling/Telemetry Interface Block Diagram



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GENCORP AEROJET

Recommended Addition To IDD NASA

6.2.1. Number Of Passive Analog Telemetry Points

The AMSU-A1 Instrument Module Shall Have Six Passive Analog Telemetry Points In Each Redundancy To Monitor The Temperature Of The Instrument. The AMSU-A2 Instrument Module Shall Have Three Passive Analog Telemetry Points In Each Redundancy To Monitor The Temperature Of The Instrument.

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Recommended Addition To IDD

NASA

Fig. 6.5.1. AMSU-A1 Source Packet Structure

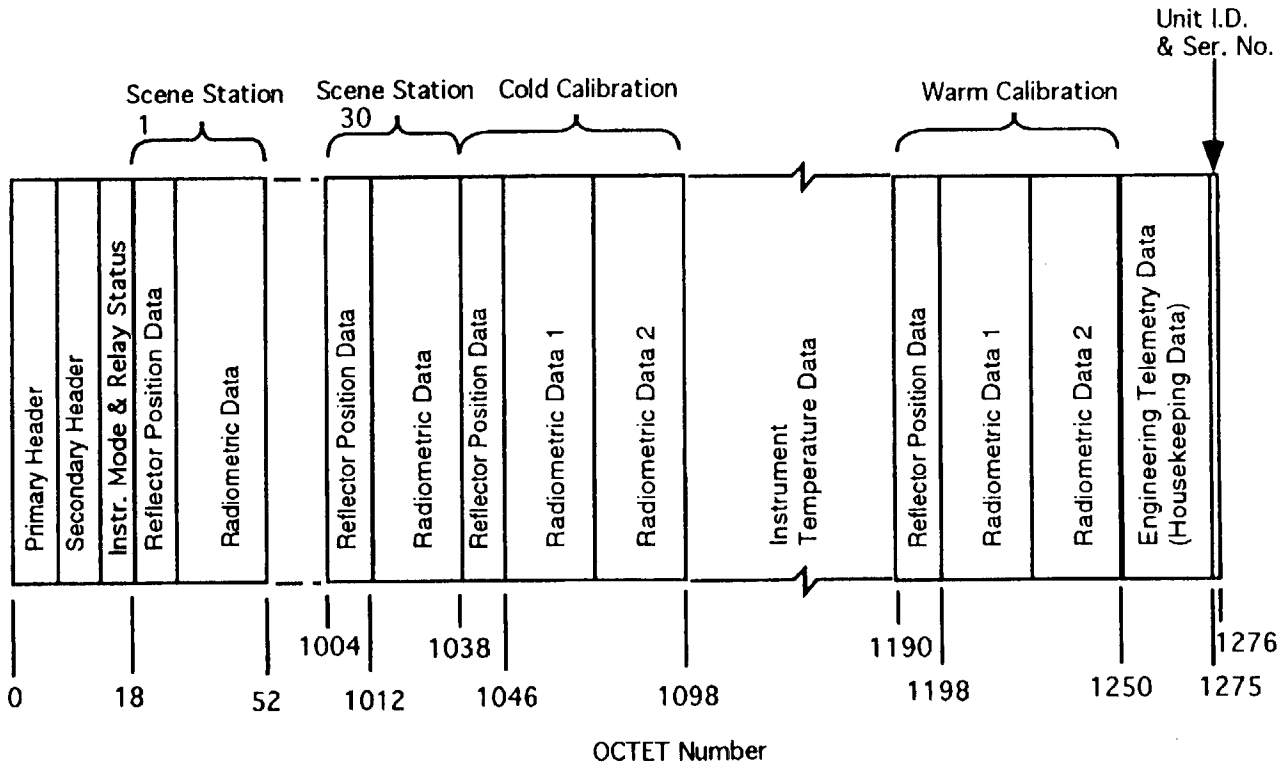

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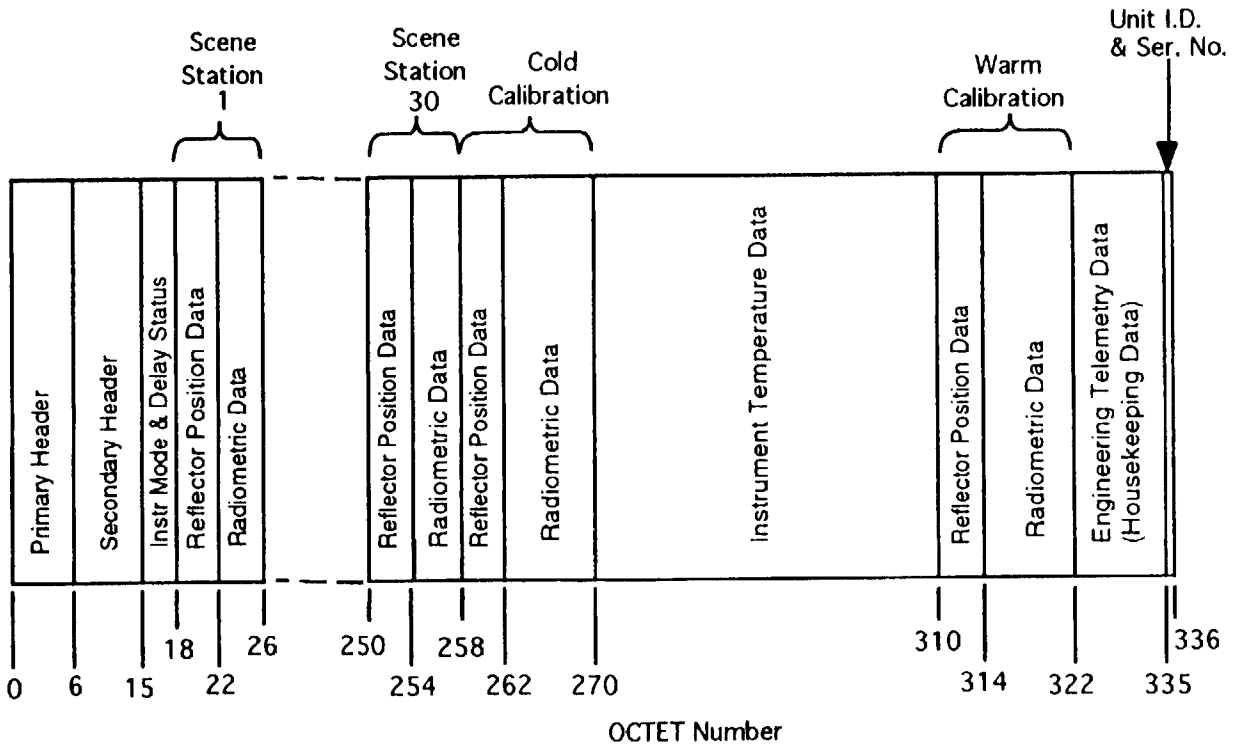
Fig. 6.5.2. AMSU-A2 Source Packet Structure



Recommended Addition To IDD NASA

6.5.1.1. Data Packetization

Packet Formats

b. Packet Length - Formatted As Per CCSDS. Telecommand Recommendations

The Length Of The Science Packet (Including The Packet Header) Directly Transmitted Over The MIL-STD-1553 Bus Will Be Restricted To No More Than 1276 Octets For The AMSU-A1 Instrument And 336 Octets For The AMSU-A2 Instrument.

~~**The Length Of The Housekeeping Packets Must Be Less Than Or Equal To 25 Octets**~~

Recommended Addition To IDD

6.5.2. Instrument Engineering Telemetry

6.5.2.1 Engineering Data Synchronization

Engineering Data Is Included In The Source Data Packet For Each Instrument Module Which Is Transmitted Asynchronously Via The Command And Data Handling Bus.

6.5.2.2. Telemetry List

AMSU-A1	
Signal Processor	+ 5V
Signal Processor	+15V
Signal Processor	–15V
Antenna Drive	+ 5V
Antenna Drive	+15V
Antenna Drive	–15V
PLLO	+15V
PLLO	–15V
PLLO	+8.5V
Receiver	+8V
GDO Voltages	(7)
PRI PLLO Lock Signal	
RDT PLLO Lock Signal	
Scan Current (Avg) A1-1	
Scan Current (Avg) A1-2	
QPB Current	
QPB Voltage	
NPB Voltage	

AMSU-A2	
Signal Processor	+ 5V
Signal Processor	+15V
Signal Processor	–15V
Antenna Drive	+ 5V
Antenna Drive	+15V
Antenna Drive	–15V
Receiver	+8V
GDO 1 Voltage	
GDO 2 Voltage	
NPB Current (Avg)	
QPB Current	
QPB Voltage	
NPB Voltage	

GENCORP AEROJET

Comment On IDD

NASA

6.4 Spacecraft-To-Instrument Transfers

It Is Assumed That Specification Items In This Section Will Be Supplied By NASA

GENCORP AEROJET

Recommended Changes To UIID NASA

Add To 5.0 Deviations/Waivers

8. **ΔI/ΔT Limits Of <50 mA/μSec For The Quiet Power Bus (GIRD Paragraph 5.1.2.2) And <500 mA/μSec For The Noisy Power Bus (GIRD Paragraph 5.1.2.3) Cannot Be Met During The First 40 μSec Following Instrument Turn On. Measured Worst Case Values Of ΔI/ΔT For The NOAA/AMSU-A Instruments Are:**

	A-1	A-2
Noisy Power Bus	744 mA/μSec	846 mA/μSec
Quiet Power Bus	677 mA/μSec	640 mA/μSec

Recommend That Spec Either Excludes First 50 μs After Turn-On Or Increases Spec. Limits For This Period

20

GENCORP AEROJET

Summary

NASA

- Minor Changes To UIID Identified
- Significant Electrical Interface Details Established For IDD
- Proposed Data Source Packet Structures Presented
- Action Item From First TIM Has Been Resolved

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NASA

EOS/AMSU-A
Contamination Control

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Agenda - Contamination Control - Lourdes Santos

NASA

- Requirements Review
- Materials Selection Criteria
- Contamination Sources And Venting Paths
- Manufacturing And Test Processes
- Cleaning Materials To Be Avoided
- Recommended Additions To The IDD
- Summary

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EOS/AMSU-A Contamination Requirements Review

NASA

- **Contamination Control Plan Will Meet MIL-STD-1246 Level 600A**
- **All Contamination Sources Will Be Identified**
- **Contamination Allowances Will Be Established**
- **Bakeout And Thermal Vacuum Requirements Will Be Specified**
- **Cleaning And Verification Procedures Will Be Established And Implemented**
- **Will Comply To Integrator's Cleanliness Requirements**

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Materials Selection Criteria Based On NASA Specification SP-R-0022

NASA

- **Materials Selection To Minimize Outgassing**
- **Conformance To NASA Outgassing Requirements**
  - **TML≤1.0% And CVCM ≤0.10%, Tested Per ASTM E-595**
  - **Outgassing Data Per NASA Reference Publication No. 1124**
- **Limited Applications Of Non-Conforming Material**

Action Item 2/2-8: Contamination Sources And Venting Paths Have Been Reviewed

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NASA

- **Non-Metallic Materials Outgassing Characteristics Were Identified**
- **Volatile Condensable Materials (VCM) From External Thermal Control Surfaces Which May Outgas And Redeposit Were Investigated**
- **Instrument Vent Path Characteristics And Locations Were Established**

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Outgassing Characteristics For Materials To Be Used On EOS/AMSU-A

NASA

MATERIAL	DESCRIPTION	AS NUMBER	TML (%)	CVCM (%)
Ablebond 240-2	Adhesive	AS 8230-95	0.44	0.07
Teflon	Plastic film	AS 8164-02	0.02	0.00
Mylar	Alum. film	AS 8225-16	0.70	0.04
Mylar	Alum.film 2 sides	AS 8225-21	0.70	0.04
Laminate	Epoxy	AS 8226-65	<1.0	<0.10
2216 B/A	Adhesive, epoxy	AS 8230-05	0.76	0.03
(w/ 3% Cab-O-Sil)		AS 8230-50		
Stycast 2850FT	Adhesive, Epoxy	AS 8230-14	0.45	0.01
(w/ Cat. #9)		AS 8230-10		
RTV 566 A/B	Adhesive, Silicone	AS 8230-22	0.13	0.01
(w/ SS4155)	Primer	AS 8230-28		
Eccobond 285	Resin, Epoxy	AS 8230-39	0.48	0.07
(w/ Cat. #9)		AS 8230-73		
463-3-8/CA118	Coating	AS 8231-26	1.43	0.07
(w/ 463-6-5/X306)	Primer	AS 8231-25		
Solithane 113	Resin	AS 8230-33	0.31	0.04
(w/ C-113-300)		AS 8230-33		
Epon 828	Resin, Epoxy	AS 8230-38	0.69	0.03
(w/ Cat. V-125)	Resin, polyamide	AS 8230-73		
Mylar	Film, Synthetic	AS 8270-01	0.59	0.00
Permacel P-224	Tape, Kapton	AS 8270-08	0.60	0.01
Silvered-Teflon	Tape	AS 8270-21	0.20	0.01
3M, #79	Tape, Glass Cloth	AS 8270-28	0.54	0.07
Protex 8216-2L	Tape, Coverlay	AS 8270-40	0.87	0.02
Goldized Kapton	Tape	AS 8270-57	0.75	0.01
Alum. Mylar	Film, 3 mils	AS8270-58	0.70	0.04

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Outgassing Characteristics For Materials To Be Used On EOS/AMSU-A (cont.)

NASA

MATERIAL	DESCRIPTION	AS NUMBER	TML (%)	CVCM (%)
Y-968	Tape, Transfer	AS 8270-87	0.81	0.01
Alum. Kapton	Tape	AS 8270-91	0.57	0.01
22DPTH	Tape, Lacing	AS 8271-02	0.40	0.02
Tefzel	Sleeving, Insulation	AS 8272-09	0.12	0.02
PTFE	Tubing, Insulation	AS 8272-11	0.00	0.00
Polyester	Hook	AS 8281-01	0.54	0.02
Uralane 5750	Coating, Conformal	AS 8230-13	0.65	0.01
Prepreg	Fiberglass, Epoxy	AS 8250-19	0.29	0.01
Acetal	Molding Compound	AS 8225-03	0.30	0.02
Laminated Plastic	Glass-epoxy	AS 8226-01	0.29	0.00
Laminated Plastic	Glass-epoxy	AS 8226-02	0.29	0.00
Laminated Plastic	Glass-epoxy	AS 8226-06	0.29	0.00
Laminated Plastic	Epoxy	AS 8226-66	0.33	0.01
Polyester	Thread	AS 8236-14	0.54	0.02
Polyester	Thread	AS 8236-15	0.54	0.02
Polyester	Thread	AS 8236-21	0.54	0.02
Polyester	Cloth	AS 8226-10	0.33	0.04
Laminated Plastic	Sheet	AS 8250-41	0.29	0.01
Laminated Plastic	Sheet	AS 8250-44	0.29	0.01
Laminated Plastic	Sheet	AS 8250-46	0.29	0.01
Mylar	Film	AS 8270-01	0.70	0.04
Solimide TA-301	Foam, polyimide		0.19	0.02
3M #850	Tape, polyester	AS 8225-32	0.70	0.02
BR-127	Primer, epoxy	AS 8230-60	0.48	0.03
Eccosorb CR-114	Adhesive, absorbant	AS 8230-59	0.26	0.01

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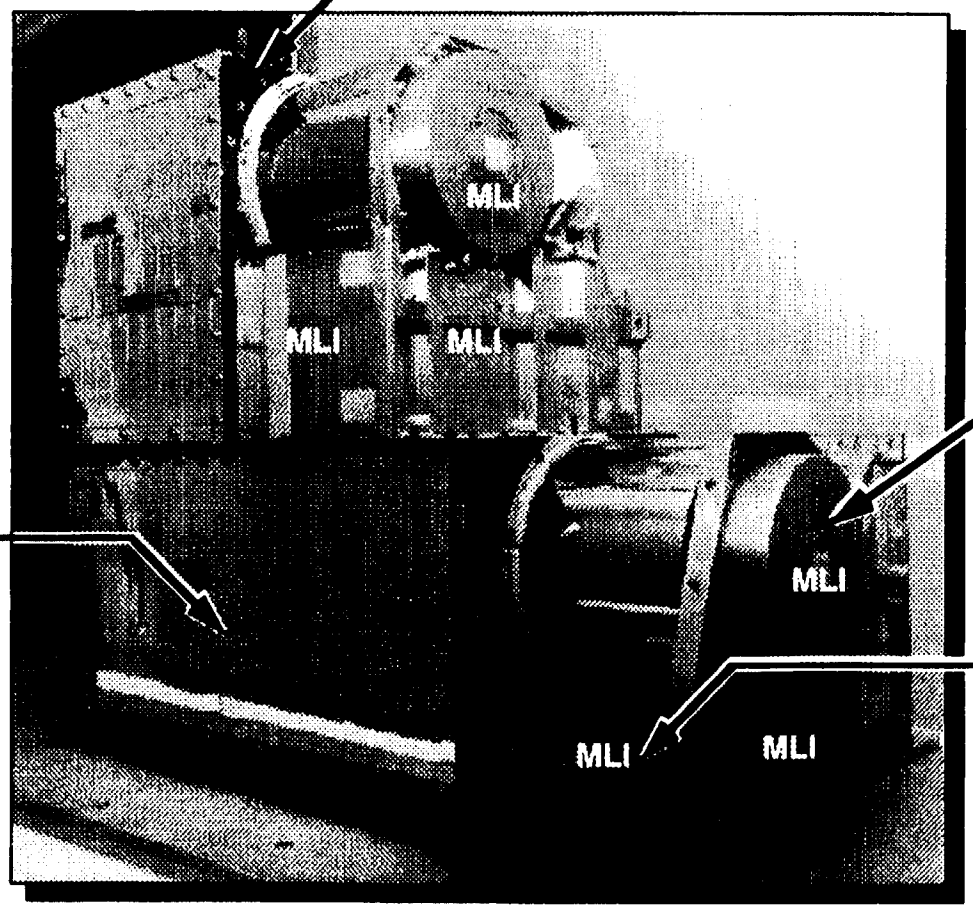
A1 Surface Materials Evaluated As Possible Contamination Sources

NASA



*Not Included In Contamination Review

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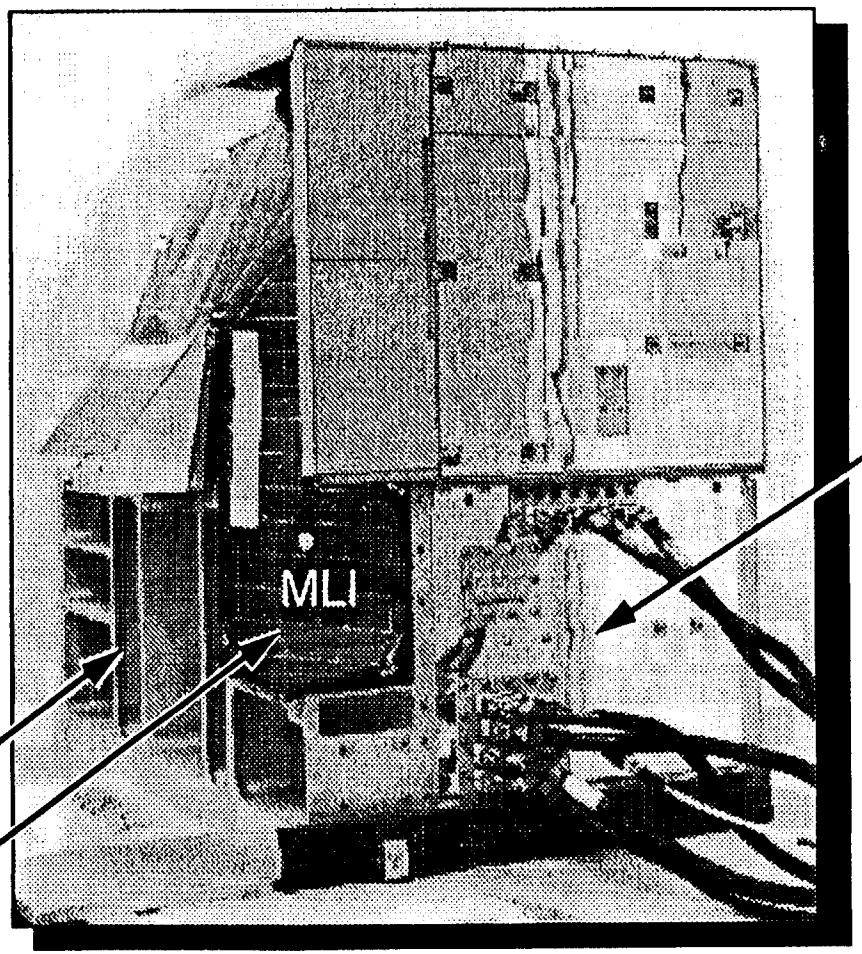
A1 Surface Materials Continued

NASA



2nd Surface Mirrors

Side Mount (NOAA)

Silvered-Teflon

A2 Surface Materials Evaluated As Possible Contamination Sources

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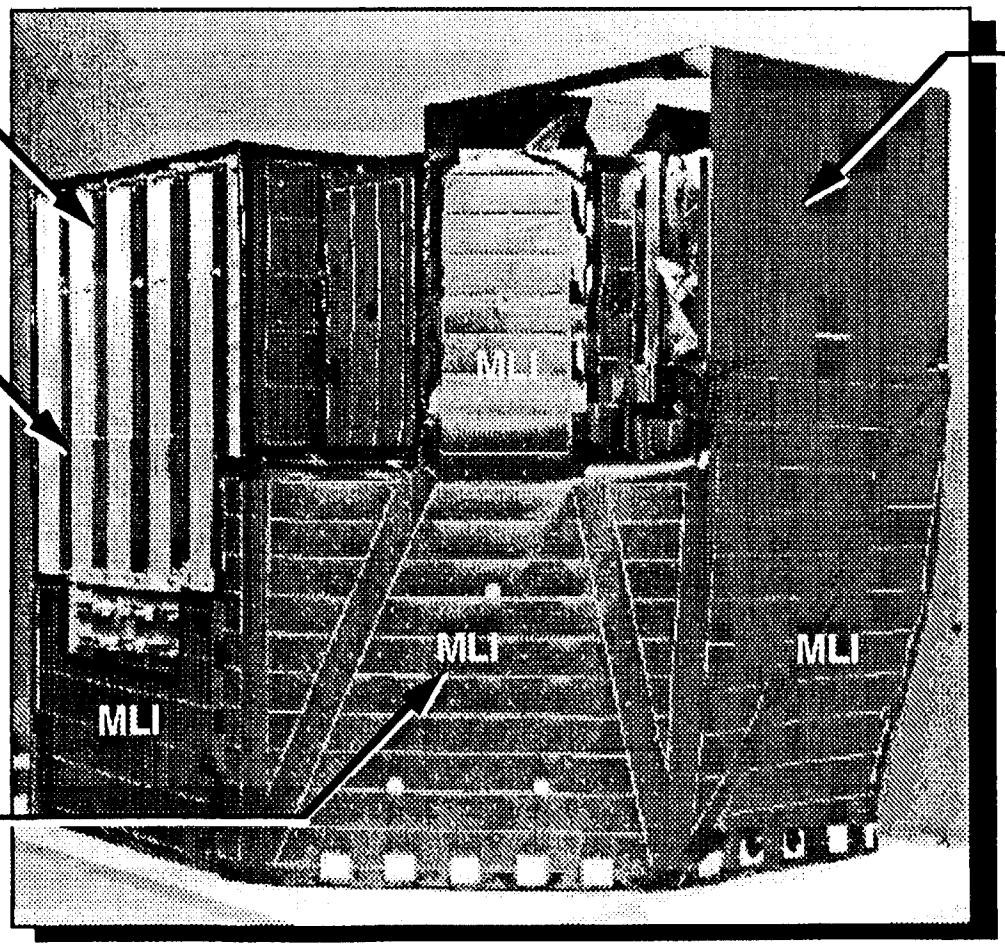
NASA



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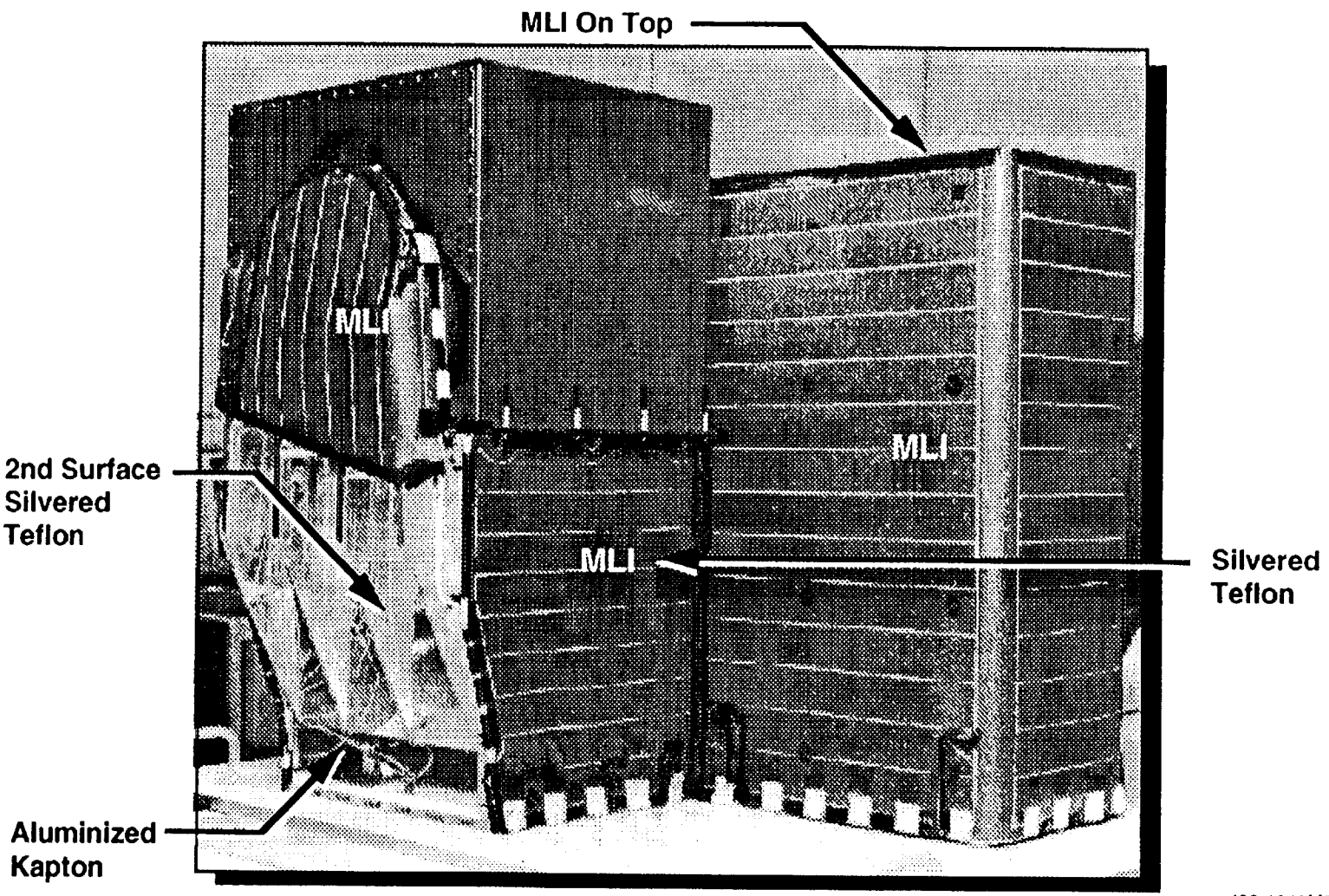
A2 Surface Materials Continued

NASA



493-1849M5-11

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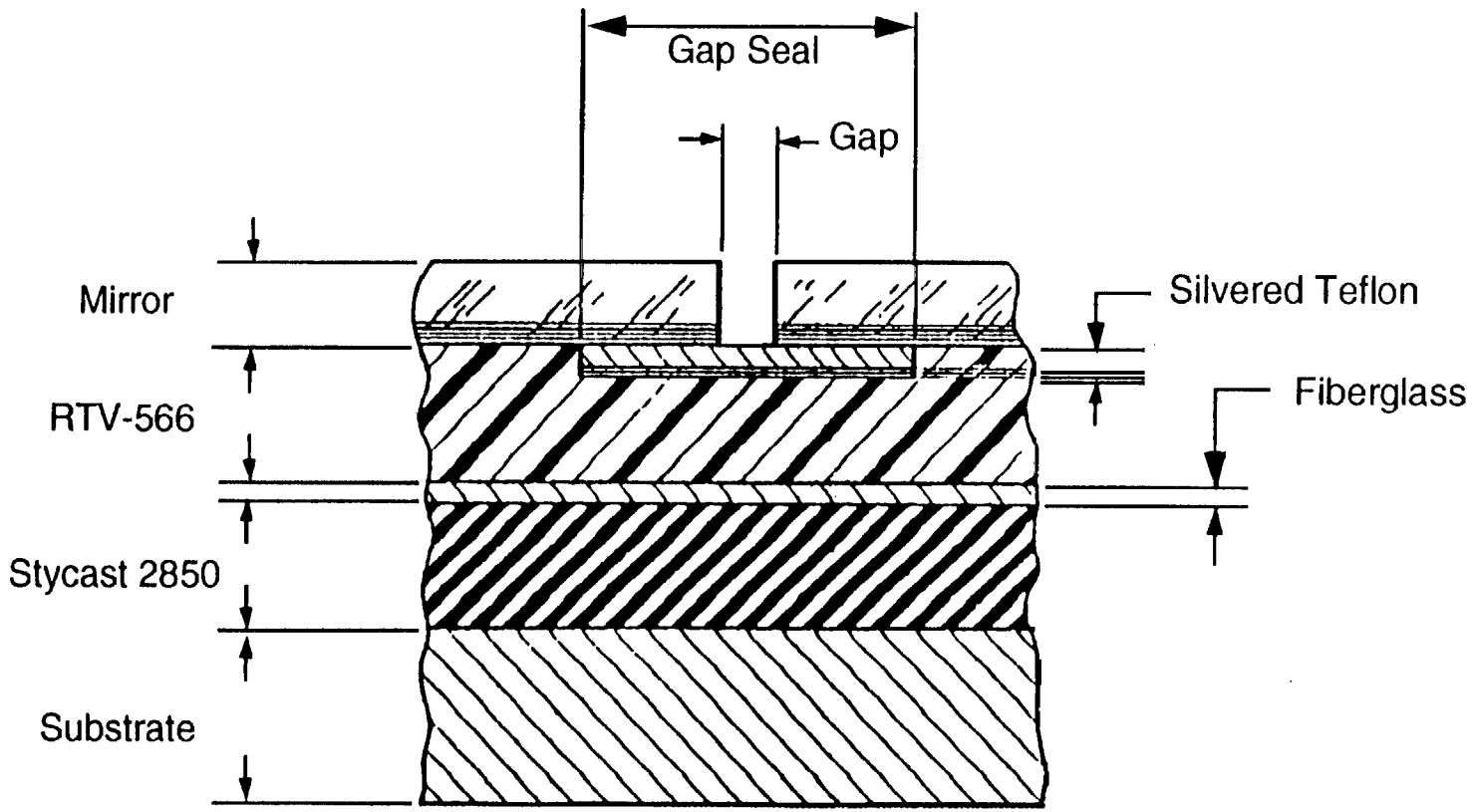
Typical Second Surface Mirrored Panel Construction (Sealed Gaps Prevent UV Exposure To Adhesive)

NASA



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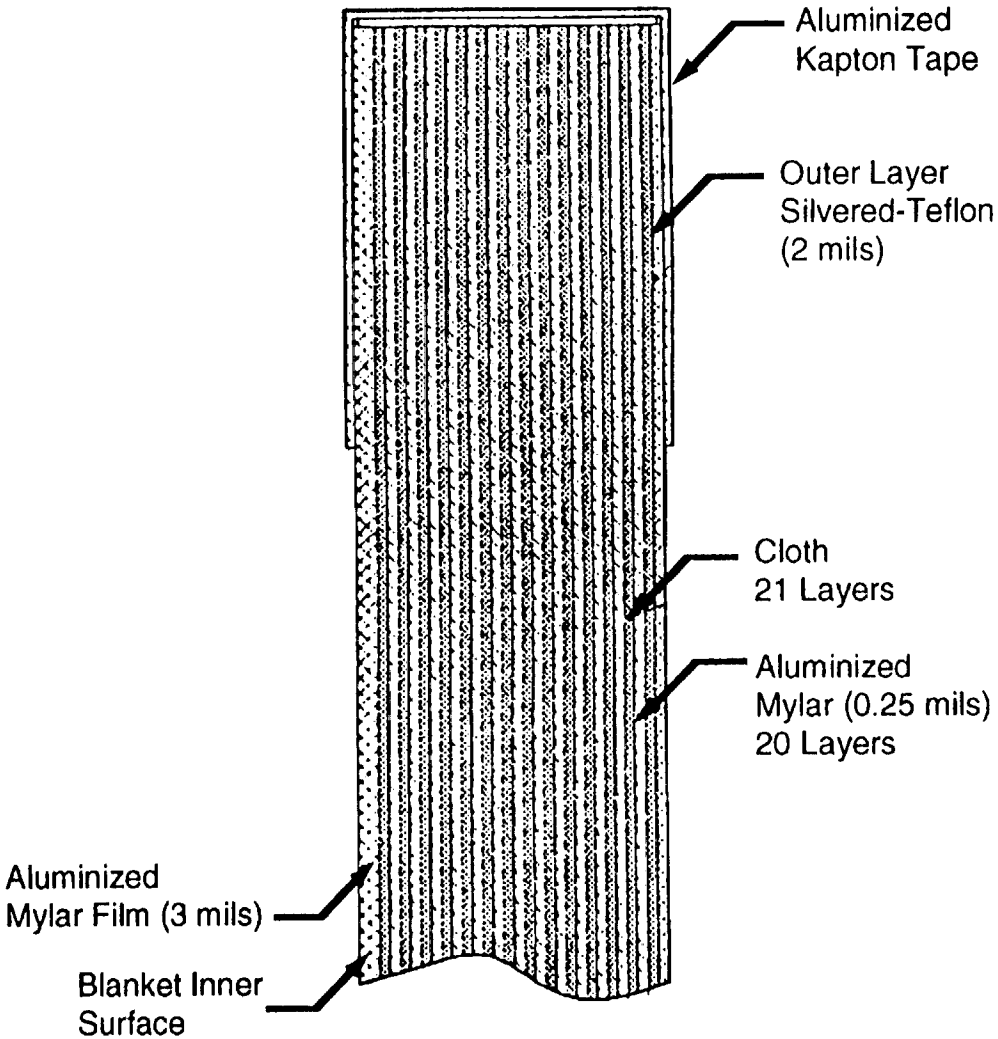
Typical MLI Blanket Construction

NASA



493-1849M5-13

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Evaluation Of External AMSU-A Contamination Sources

NASA

- **Estimate Of Volatile Condensable Materials (VCMs) Which May Outgas And Are Available For Redeposition:**

AMSU-A1		AMSU-A2	
Second-Surface Mirrored-Panels:	0.0048 g	MLI Blankets:	0.0730 g
MLI Blankets:	0.0024 g	Aluminized Kapton:	0.0011 g
		Silvered-Teflon:	0.0035 g

- **Based On Worst-Case Analysis - Prior To Bake-outs And Vacuum Thermal Cycling**

- **Significant Contamination Reduction Expected After Bakeout Conditioning (At Least One Order Of Magnitude)**

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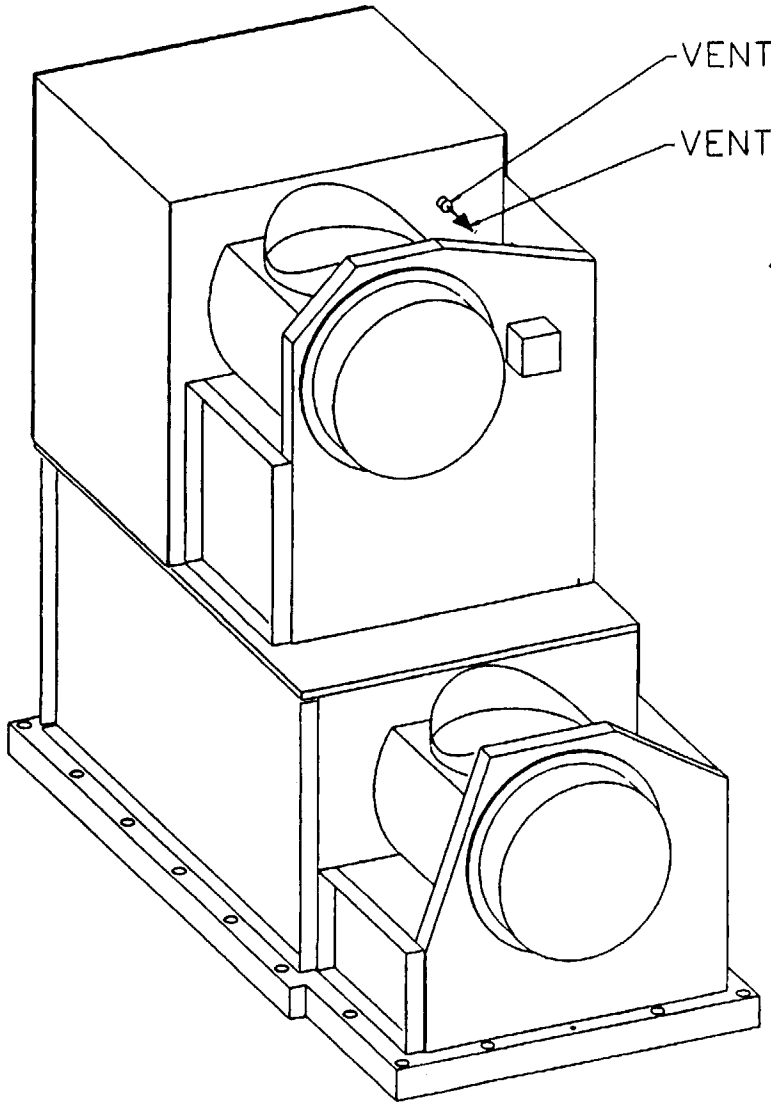
AMSU-A1 Vent Path Not In Direct Line Of Sight To Other Instruments

NASA



Tube Size: 1/4" I.D.

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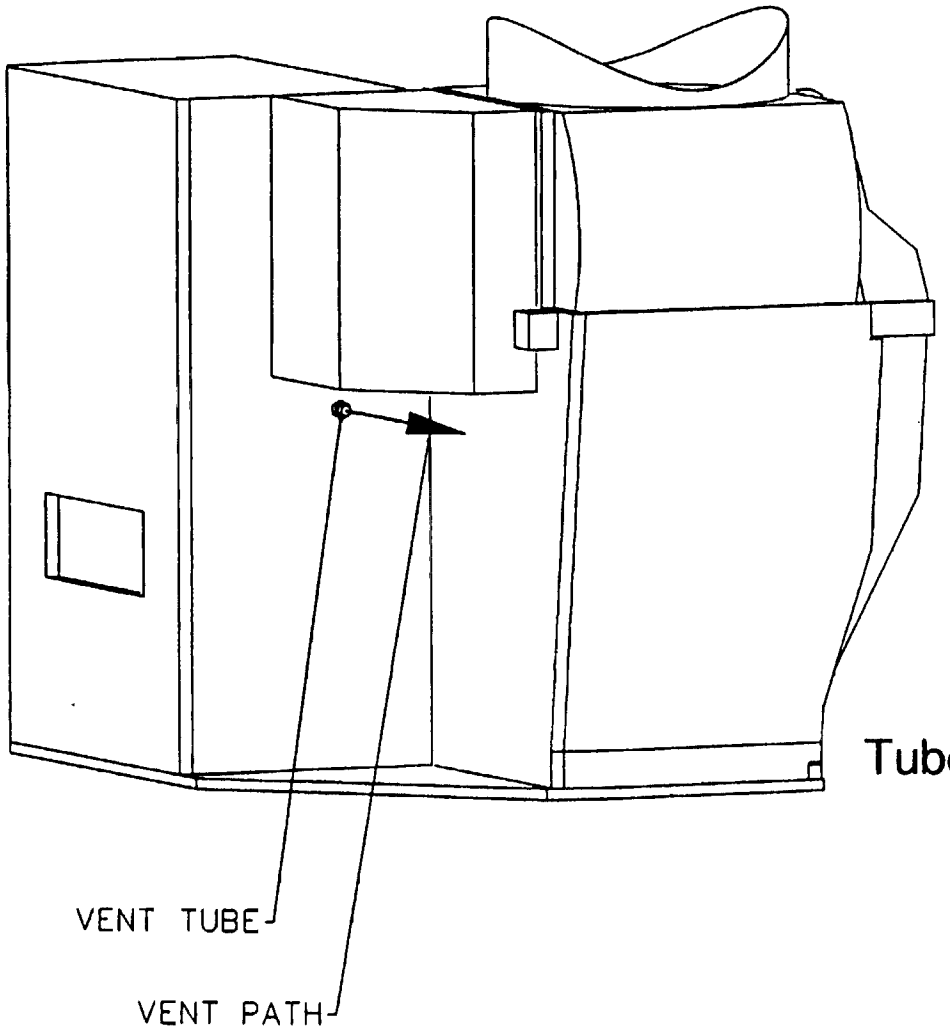
MLI Blanket Covers AMSU-A2 Vent Path

NASA



Tube Size: 1/4" I.D.

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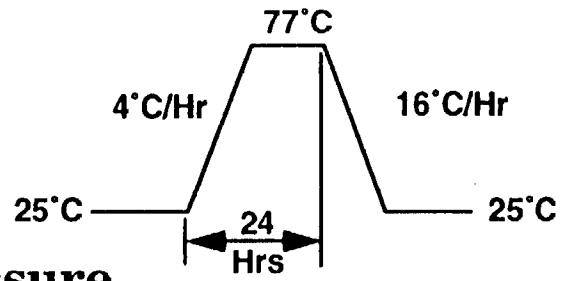
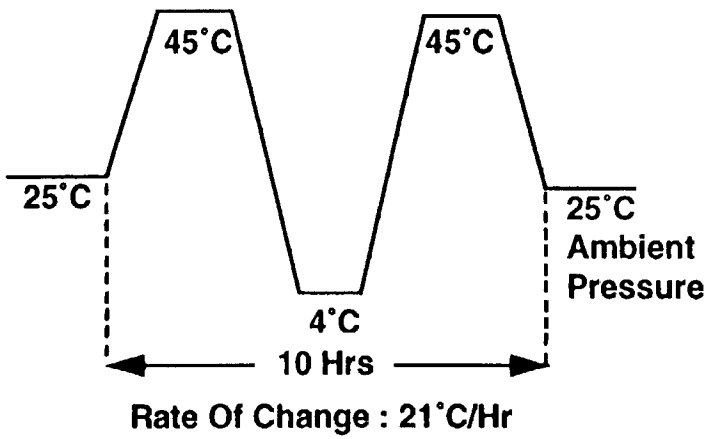
Manufacturing And Test Processes

NASA

- **MLI And Wiring Harness Bakeouts**
  - **$1x10^{-5}$ Torr: 72 Hours @ 70°C**
- **Second Surface Mirrors Thermal Conditioning**
  - **Ambient Pressure:**



  - **Thermal Vacuum Pressure ($1x10^{-4}$ Torr):**



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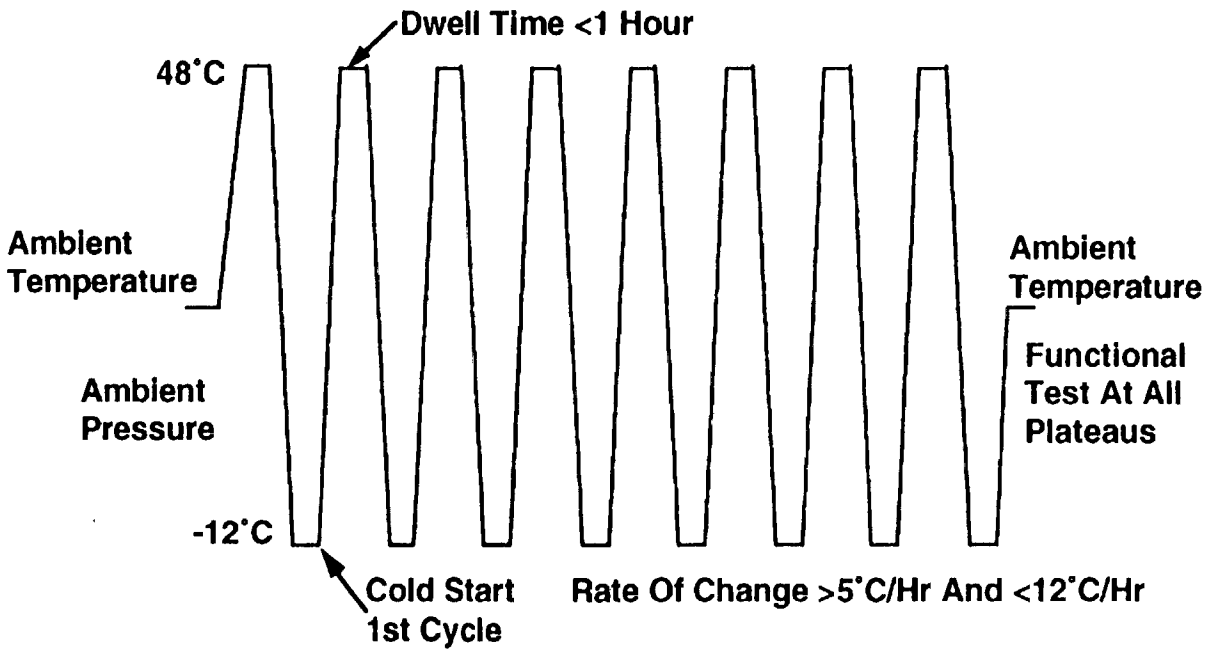
Manufacturing And Test Processes

NASA

- **Thermal Cycling - System Level**



  - **Typical Total Time = 5 To 6 Days**

C-2

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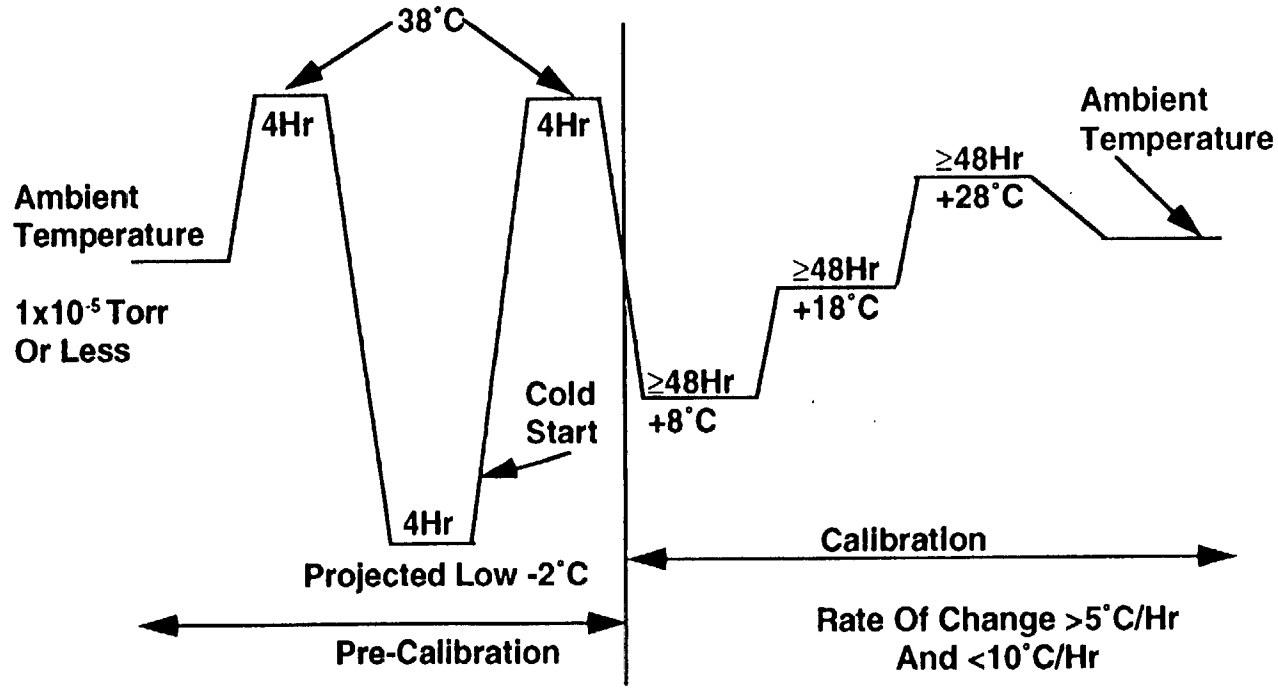
Manufacturing And Test Processes

NASA

- **Vacuum Thermal Cycling - System Level**



- **Typical Total Test Time = 18 To 20 Days**
- **Cleanliness Monitored Using Witness Plates And TQCM**

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Action Item 2/2-7
Cleaning Materials To Be Avoided

NASA

- **Environmentally Incompatible Solvents**
  - **Freons**
  - **1, 1, 1 - Trichloroethane**
  - **Chloroform**
  - **Methylene Chloride**

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Recommended Additions To The Instrument Description Document (IDD)

NASA

- **Section 7.2.2** — **Purge Requirements**
- **Recommendation:** — **Use Dry Nitrogen (GN_2) For Purging Per MIL-P-27401 (Type I, Grade B Or Better)**
- **Section 7.2.4** — **Solvents Compatibility**
- **Recommendations:** — **Use n-Hexane/Ethanol Mixture For Second Surface Mirrors. Use Isopropanol For Silvered-Teflon, Goldized-Kapton And Aluminized Kapton Surfaces**
- **Section 7.2.7 And Action Item 2/2-9** — **Temperature And Humidity Requirements During Integration And Test**
- **Recommendations:** — **Temperature: 24± 6°C Relative Humidity: 25 To 60% (As Specified In Aerojet Product Specification AE-25089)**

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Summary

NASA

- **Contamination Control Plan Will Be Developed And Program Implemented To Meet Requirements**
- **AMSU-A Materials Selection Based On Low-Outgassing Criteria**
- **Bakeout And Vacuum Thermal Cycling Processes Will Further Reduce Or Eliminate Volatile Species - Verified By Sampling Techniques**
- **Cleaning And Verification Processes Will Achieve Cleanliness Goals**

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Cleaning And Verification Processes

NASA

- Prior To Shipment
  - Cleaning Of External Surfaces Using Wipedown Methods
  - Cleanliness Verification By Wipe-Sampling Methods Followed By Extractive Analysis
- At Integrating Contractor Site
  - Cleanliness Reverification Of External Surfaces

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NASA

Integration And Test Of AMSU-A On EOS Spacecraft

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Agenda - Integration And Test Of AMSU-A On EOS Spacecraft

W. Chapman

NASA

- UIID Inputs

- IDD Inputs

UIID Inputs

Section 4.0: Operation And Handling Constraints To Prevent Damage Or Degradation

- Personnel Must Wear Grounded Wrist Straps When Touching The Instrument
- Drive Motor Bearings To Be Dry-Nitrogen Purged When Instrument Not In Clean Room
- Instrument Must Be Handled Per Instrument Handling Procedure

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IDD Inputs

NASA

Paragraph 3.12 Handling

- Instrument Hardpoints - See Figures On Following Pages
- Listing Of Mechanical Ground Support Equipment Verified - No Change Required

IDD Section 3.12 - AMSU-A1 Hard Point Locations And Handling Fixtures

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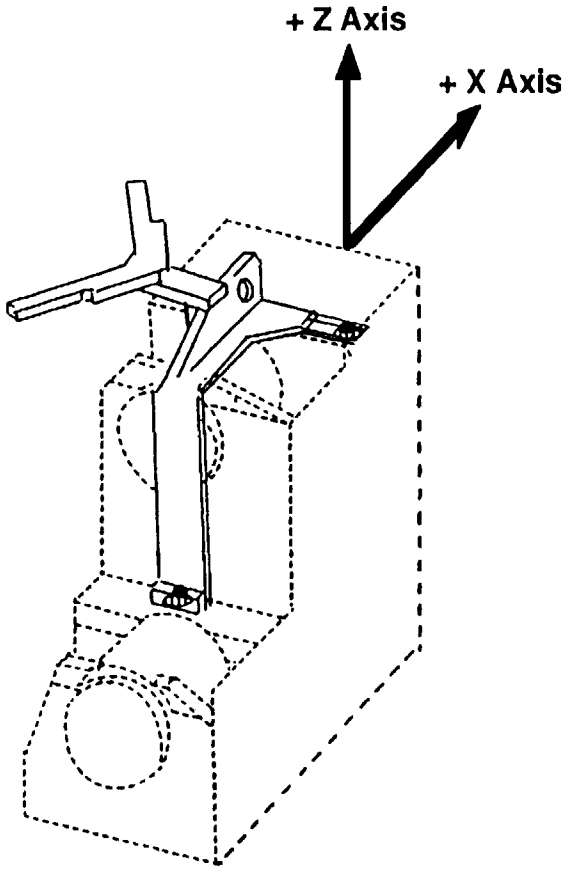
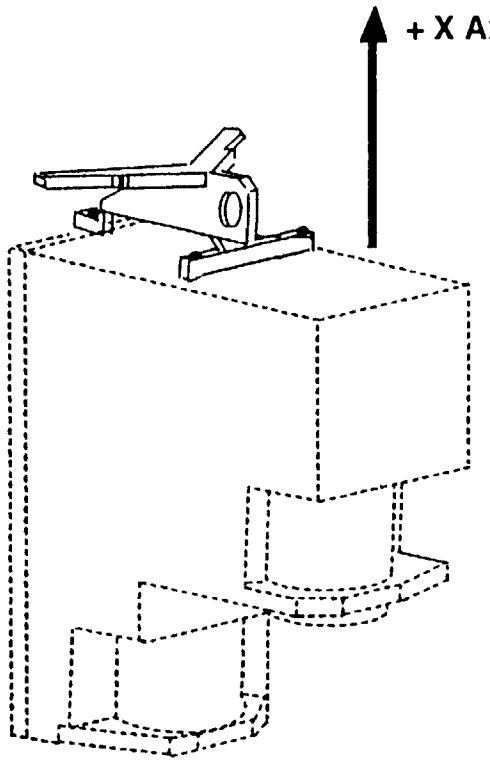
NASA





Note:
Antenna Covers Removed For Clarity. During Actual Use Antenna Covers Must Be In Place.

Software

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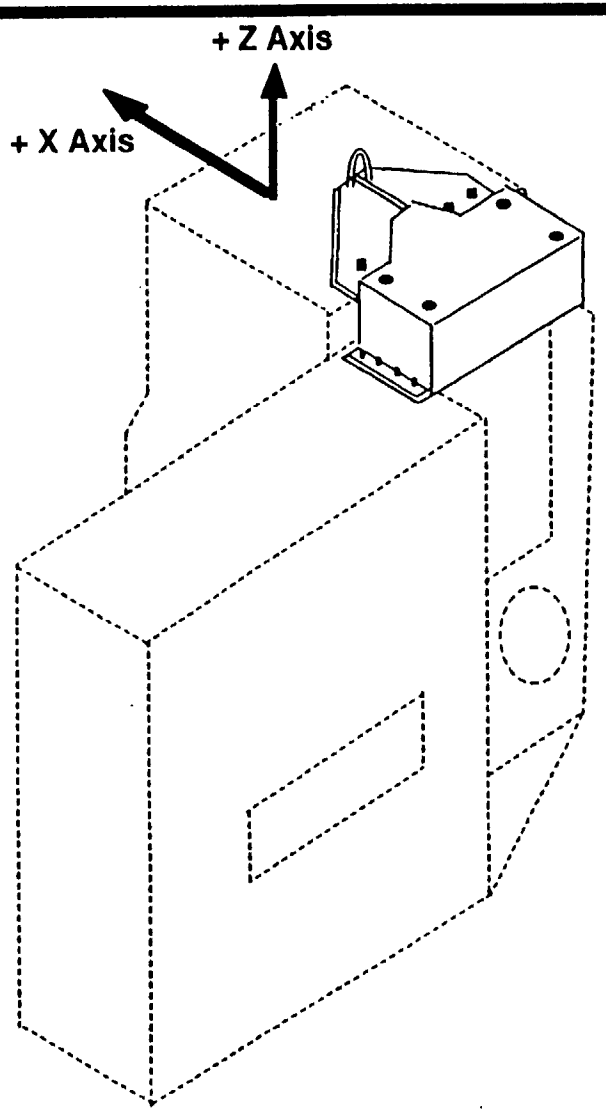
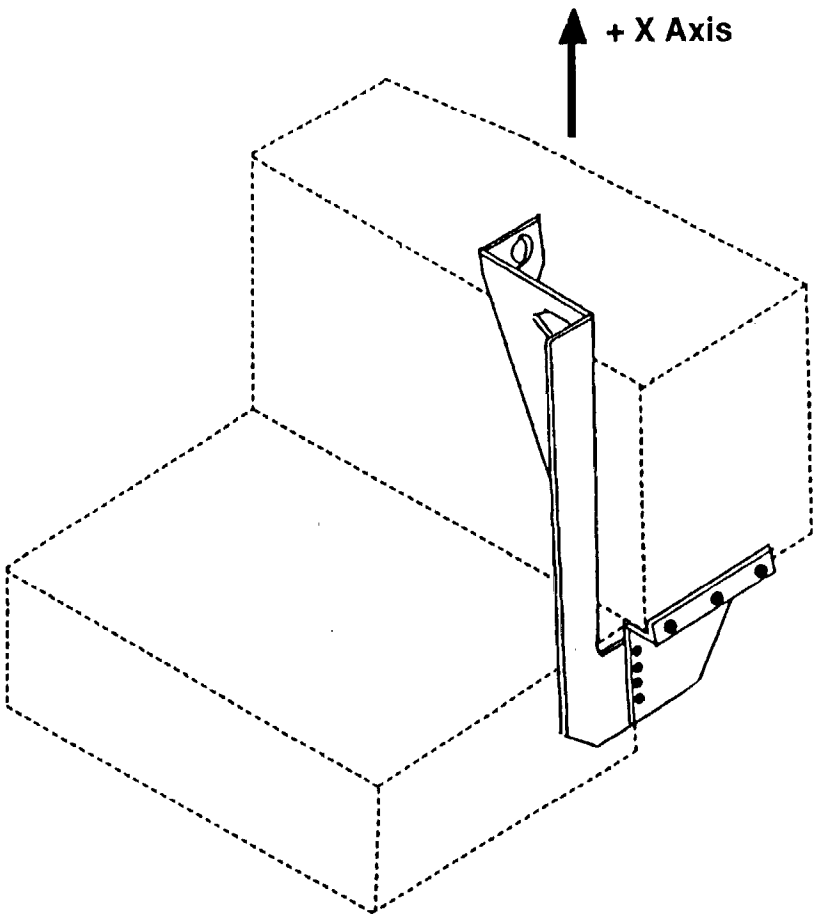
IDD Section 3.12 - AMSU-A2 Hard Point Locations And Handling Fixtures

NASA





Software

- **UIID** **Recommend That A Deviation (Or Clarification) Be Added To Section 5.**
  Requirement: EOS System Test Operating Language (ESTOL) To Be Used For "Instrument Test Procedures" (GIRD Paragraph 3.1).
  Deviation Recommended: ESTOL Is Required For All Software That Interfaces With The Spacecraft And Associated STE (But Not All "Instrument Test Procedures" Software)

- **IDD (Section 8) Suggested Minor Changes Provided As Separate Input**

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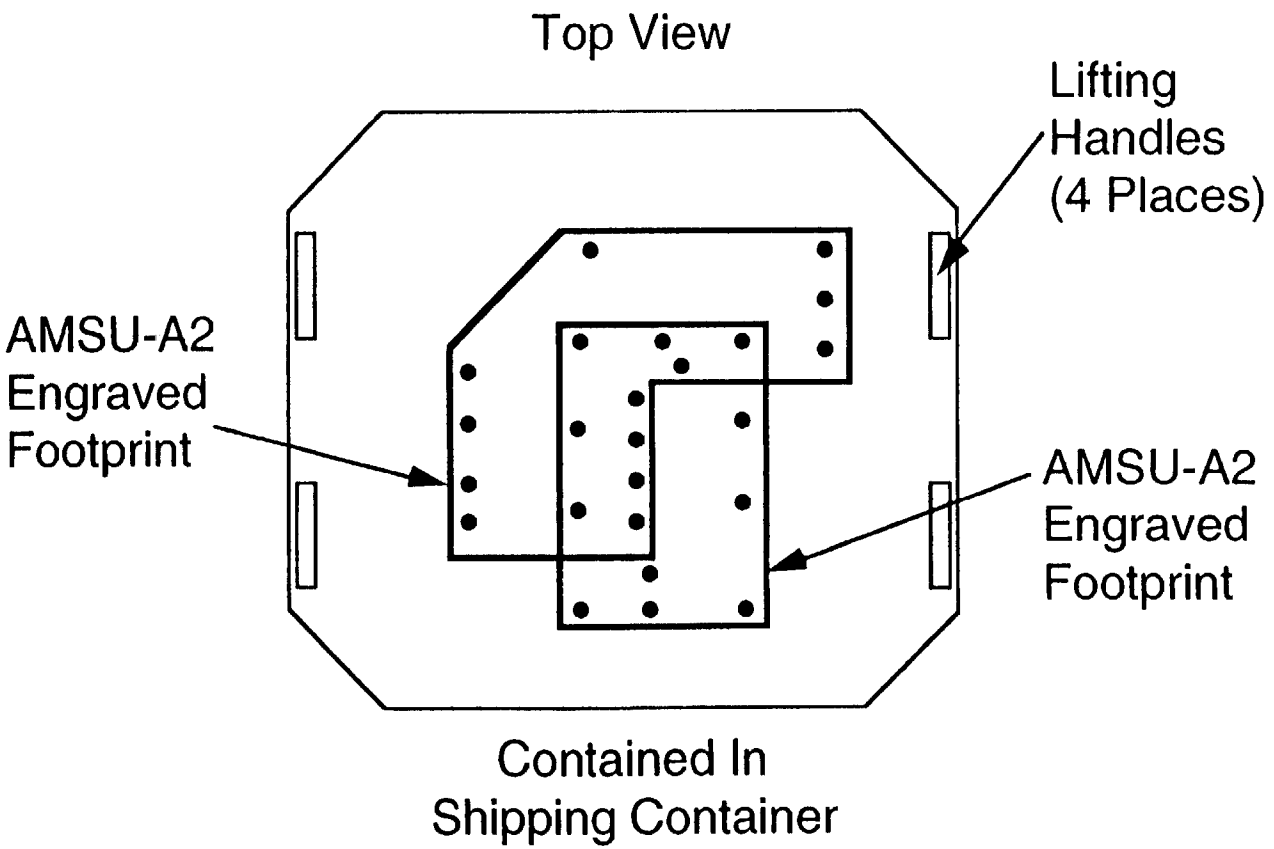
AMSU-A1 And AMSU-A2 Handling Plate

NASA



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AMSU-A IDD Integration and Test Requirements

NASA

Section 9 Integration and Test, Modify As Shown:

9. INTEGRATION AND TEST

9.1 OBSERVATORY LEVEL TEST/CALIBRATION REQUIREMENTS
Internal Warm Targets, External Cold Targets

9.2 MECHANICAL GSE LIST
AMSU-A1 Spacecraft Integration Fixture
AMSU-A2 Spacecraft Integration Fixture
AMSU-A1 Mounting Template
AMSU-A2 Mounting Template
AMSU-A1 Shipping / Storage Container
AMSU-A2 Shipping / Storage Container
~~Installation Dolly Assembly~~ AMSU-A1 Handling Plate
~~Handling Dolly~~ AMSU-A2 Handling Plate
~~AMSU-A1 Rotating Sling Assembly~~
~~AMSU-A2 Rotating Sling Assembly~~

9.3 ELECTRICAL GSE LIST
Special Test Equipment
- ~~a. Micro VAX II Computer~~ Aerojet Work Station
- b. Interface Module
- ~~c. Power Distribution Panel~~
- ~~d. Power Supply~~
- e. Interface Cabling
- ~~f. Equipment Rack~~
- g. Printer
- ~~h. Tape Recorder~~
- ~~i. VDT~~
- ~~j. Keyboard~~
- ~~k. Cable Set~~

Bench Check Unit

9.4 STIMULUS GSE LIST
External Cold Targets:
- AMSU-A1 ~~variable~~ target assembly
- AMSU-A2 ~~variable~~ target assembly

9.5 INTEGRATION AND TEST FACILITY REQUIREMENTS TO SUPPORT INSTRUMENT CHECKOUT
Liquid Nitrogen Supply, External Cold Target Mounting Fixture ← ETHERNET Local Area Network (for Aerojet Work Station)

9.6 LAUNCH SITE EQUIPMENT INSTALLATION AND REMOVAL
Aperture Cover Removal
Fairing Cover Removal

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NASA

EOS/AMSU-A EMI/EMC And Magnetic Fields

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Agenda - EMI/EMC And Magnetic Fields

NASA

- Requirements And Ramifications
- Radiometric Sensitivity
- Summary

GENCORP AEROJET Comparison Of AMSU-A EMI/EMC Test Requirements For NOAA And AMSU/EOS NASA

MIL-STD-462 Test Method	Test Description	Test Requirements/Comments
CE01	Conducted Emissions, Power Line - 30 Hz to 15 kHz Narrowband	EOS Requirement Same As Original NOAA. NOAA Prototype Tests Indicated Negligible Emissions. NOAA Test Requirement Was Deleted On Subsequent Units.

Action: • No Narrowband Signals Anticipated In The Design.
• No Action Required

CE03	Conducted Emissions, Power Line - 15 kHz to 50 MHz Narrowband	EOS Requirement Approximately The Same As NOAA Original Requirement. NOAA Units Unable To Meet Original Requirement. Limits Were Relaxed Approximately 30 To 60 dB And The Frequency Range Was Reduced To 20 kHz To 150 kHz.
CE03	Conducted Emissions, Power Line - 15 kHz to 50 MHz Broadband	EOS Requirement Approximately The Same As NOAA Original Requirement. NOAA Units Unable To Meet Original Requirement. Requirement Was Deleted.

Action: • Separate Internal Wiring - Input Power Leads From Other Wiring.
• Improve Powerline Filter And/Or Power Supply Isolation.
• Relocate Input Power Connector.
• Since Some Emissions Are Related To The Test Set Signals, The Following Are Necessary.
  – Test Set Improvements To Meet EMI Requirements
  – Special Cables For EMI Test.
  – Bulkhead Filter For The Shielded Enclosure.

CE06	Conducted Emissions, Antenna Terminal	Not Required For NOAA. Should Not Be A Requirement For A Dedicated Antenna (Only For Shared Antennas).

Action: • Recommend Deletion Of This Requirement

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Comparison Of AMSU-A EMI/EMC Test Requirements For NOAA And AMSU/EOS (Cont)

NASA

MIL-STD-462 Test Method	Test Description	Test Requirements/Comments
CS01	Conducted Susceptibility, Power Line - 30 Hz to 50 kHz Narrowband	EOS Requirement Approximately The Same As NOAA Original Requirement. One NOAA Unit was tested To 3 VRMS W/O Problem. Susceptibility Levels Were Subsequently Reduced Substantially And The Frequency Range Was Extended To 150 kHz

Action:
- High Probability Of Meeting Requirement
- No Action Anticipated

CS02	Conducted Susceptibility, Power Line - 50 kHz To 400 MHz	EOS Requirement Approximately The Same As NOAA Original Requirement. NOAA Requirement Was Deleted When CSOI Was Extended To 150 kHz

Action:
- No Information Available
- Possible Problem Areas
- CEO3 Fixes Can Help With Compliance
- Improve Grounding And Minimize Ground Loops

CS06	Conducted Susceptibility, Power Line - Transient Spike	EOS Requirement Is Less Stringent Than The NOAA Original Requirement. On NOAA Unit Was Tested To 56 V Peak W/O Problem. Susceptibility Levels Were Subsequently Reduced Substantially.

Action:
- Can Meet A 24 Volt Spike At 10 Microsecond Pulse Duration
- No Action Anticipated

GENCORP AEROJET Comparison Of AMSU-A EMI/EMC Test Requirements For NOAA And AMSU/EOS NASA

MIL-STD-462 Test Method	Test Description	Test Requirements/Comments
RE01/RE04	Radiated Emissions, Magnetic Field - 30 Hz To 50 kHz	No NOAA Requirement Per RE01, i.e., 7cm From Side Of The Unit. EOS Requirement Is The Same As NOAA Requirement Per RE04, i.e.,1 Meter From Unit. NOAA Prototype Tests Indicate Negligible Emissions. NOAA Test Requirement Was Deleted On Subsequent Units.

Action:
- No Data Available At 7cm From The Wall Of The Unit Per RE01
- No Narrowband Emissions Were Noted AT 1 Meter From Unit Per RE04
- No Narrowband Generated In The Test Frequency Range
- No Action Anticipated

RE01	Radiated Emissions, dc Magnetic Field	Comparable Requirements; Met For NOAA

Action:
- NOAA/AMSU-A Units Meet 1 Milligauss, 1 Meter From Center Of Unit
- Measurement Will Be Performed 1 Meter From Edge Of Unit
- Can Meet A Dipole Moment Of 500 Pole - cm
- No Action Anticipated

GENCORP AEROJET Comparison Of AMSU-A EMI/EMC Test Requirements For NOAA And AMSU/EOS NASA

MIL-STD-462 Test Method	Test Description	Test Requirements/Comments
RE02	Radiated Emissions, 14 kHz To 18 Ghz Narrowband	EOS Requirements Are More Stringent Than The NOAA Requirements, Limits Are Lower By 10 To 15 dB. Frequency Spectrum Is Extended From 2 GHz To 18 GHz.

Action:
- Present Data Indicate Emissions Will Exceed Limit
- No Test Data Above 2.04 GHz
- Most Electric Field Emissions Are Related To Test Set Data And Cable Radiations
- CE03 Fixes Can Assist In The Compliance Of This Requirement
- Test Set-Up Needs To Be Improved In Order To Show The Actual Emissions From AMSU-A Unit
- Filter Pin Connectors Are Required With Attenuation Tested To 10 GHz
- Broadband Emissions Will Follow Narrowband Emission Reductions

RE02	Radiated Emissions, Special Frequency	NOAA Requirement Met; NOAA Has 15 Special Frequencies Only One Compares With EOS Requirement, i.e., 2 GHz.

Action:
- No Emissions Above 0 dBμV/m Were Detected From 2.01 To 2.04 GHz
- No Test Data Available For 2.2 GHz
- No Action Anticipated

GENCORP AEROJET Comparison Of AMSU-A EMI/EMC Test Requirements For NOAA And AMSU/EOS NASA

MIL-STD-462 Test Method	Test Description	Test Requirements/Comments
RS01	Radiated Susceptibility - 30 Hz To 200 kHz Magnetic Field	Not Required For NOAA. Can probably Meet Requirement. Narrowband Magnetic Fields Will Not Affect This System

Action:
- No Test Data Available
- Preliminary Analysis Indicates, No Susceptibility Is Anticipated In This Frequency Range From A Level Of 124 dBpT (16 Milligauss) 7cm From Wall Of Unit
- No Action Anticipated

RS01	Radiated Susceptibility, D.C. Magnetic Field	Not Required For NOAA; Worst-Case Field Could Be A Problem For Microwave Isolators, Which Have Magnetic Elements.

Action:
- No Test Data Available
- Initial Analysis Indicate, No Susceptibility Is Anticipated With An Approximately 3 Milligauss DC Magnetic Field.
- Initial Analysis Indicate Possible Susceptibility Effects Could Be Experienced With And Approximate 10 Gauss DC Magnetic Field
- More Analysis Required
- Relocation Of RF Devices Needs To Be Considered
- Provide Anticipated Magnetic Field Produced By The Magnetic Torquers Of The S/C At The Instrument Location

GENCORP AEROJET Comparison Of AMSU-A EMI/EMC Test Requirements For NOAA And AMSU/EOS NASA

MIL-STD-462 Test Method	Test Description	Test Requirements/Comments
RS03	Radiated Susceptibility - 14 kHz To 18 GHz Electric Field	No Problem To 2 GHz; Untested 2-18 GHz. Could Be A Problem

Action:
- Data Available From 150 kHz To 500 MHz At 1 Volt/Meter
- No Problems Anticipated At 2 Volts/Meter From 14 kHz To 2 GHz
- Frequency Range 2 To 18 GHz At 10 Volts/Meter Possible Problems
  - Increase Shielding
  - Test Equipment Needs To Eliminate Harmonic Generation To Prevent False Response

RS03	Radiated Susceptibility, Electric Field, Special Frequency	NOAA Requirement Met; EOS Requirements Frequencies And Electric Field Levels Will Be A Problem

Action:
- Electric Field Susceptibility Levels Are High:
  - 2.287 GHz 50 Volts/Meter
  - 8.212 GHz 42 Volts/Meter
  - 15.003 GHz 22 Volts/Meter
- Possible Problem When Field Is Directed Toward The Antenna
- Possible Interference At 2.287 GHz, On Channel 15
- Possible Interference At 15.003 GHz, If Second Harmonic Is Not 131 dBm, Below Fundamental, On Channel 2
- Filter Pin Connectors Are Required With Attenuation Tested To 10 GHz
- Provide Anticipated Electric Field At The Instrument Location

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Radiometric Sensitivity & Shielding Effectiveness (SE) Requirements

NASA

CH. NO.	Center Frequency MHz	NO.Of Pass Bands	Band-width (MHz)	Sensitivity (dBm)	RS03 Electric Field Levels (dBm)	SE Requirement (dB)
1	23800	1	270	-90	+19	109
2	31400	1	180	-91	+19	110
3	50300	1	180	-91	+19	110
4	52800	1	400	-88	+19	107
5	53596 ±115	2	170	-92	+19	111
6	54400	1	400	-88	+19	107
7	54940	1	400	-88	+19	107
8	55500	1	330	-89	+19	108
9	57290.344 =fLO	1	330	-89	+19	108
10	fLO±217	2	78	-95	+19	114
11	fLO±322.2±48	4	36	-98	+19	117
12	fLO±322.2±22	4	16	-102	+19	121
13	fLO±322.2±10	4	8	-105	+19	124
14	fLO±322.2±4.5	4	3	-109	+19	128
15	89000	1	3000	-79	+47	126

Shielding Effectiveness Of The AMSU-A RF Compartment: 140 dB
Components, Cables, And Connectors: 60 dB
AMSU-A Structure: 80 dB

Summary

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EMI/EMC Action Items Are Complete

NASA

Action Item	Description
2/2-13	Provide Radiometric Sensitivities (Instrument RF Subsystem)
2/2-14	Provide EMI/EMC Sensitivities To Transmitters
2/2-22	Complete The EMI/EMC Assessment (GIRD Requirements)
2/2-21	Assess Impact Of CS06-24 Volt Spike Accommodation

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Summary

NASA

- **Recommended Changes To UIID**

  - **Mechanical -** **Envelope, Access, FOV, Alignment.**

    Modify Envelope Allocations Per Revised Figures 1 & 2

    Clarify FOV Locations Per Revised Figures 3 & 4.

Summary

- **Recommended Changes To UIID (Cont)**

– Mechanical	**Mass Properties, Structures, Torque**
Section 3.1.3	**Reallocate The 110 Kg Weight Allocation; 60 To A-1, 50 To A-2**
Section 5.0	**Raise Disturbance Torque Limit To 60 In-Lb To Allow For Unit-To-Unit Variations**
Section 5.0	**Provide Waiver To GIRD Requirement (Para. 3.3.3.2) To Measure Center Of Mass**

Summary (Cont.)

- **Recommended Changes To UIID (Cont)**
  - **Thermal**

    5.0 **Increase A-1 Allowable Heat Transfer To Spacecraft To 25 W/m² (From 17.5 W/m²)**

  -

    5.0 **Increase Instrument (A-1 Plus A-2) Survival Power Allocation To 50%**

  - **Electrical, Command & Data Handling**

    3.3.1 **Revise Individual Power Allocations To A-1 & A-2; No Change To Total Power Allocation**

    5.0 **Provide Deviation To Allow Higher $\Delta I/\Delta T$ During Instrument Turn-On (GIRD Paras. 5.1.2.2 & 5.1.2.3)**

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Summary (Cont)

NASA

- **Recommended Changes To UIID (Cont)**

  - **Software 5.0** **Clarify Requirement Regarding ESTOL. Deviation Recommended: ESTOL Is Required For All Software That Interfaces With The Spacecraft And Associated STE (But Not All "Instrument Test Procedures" Software)**

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Summary (Cont)

NASA

- IDD Input Summary
  - Inputs Provided To Eliminate All Critical TBD's And The Vast Majority Of All TBD's
  - All Missing Diagrams And Tables Provided
  - Additional Data Will Be Provided As Needed
- Baseline Inputs Provided
  - AMSU-A Contamination Source Data
  - Environments Assessment
    - Vibration Acoustics, Acceleration, Shock, Launch Pressure
    - EMI/EMC And Magnetic
- All Action Items From February Interface Meeting Completed

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Summary

NASA

- EMI/EMC Requirements For CE01, CS01, CS06, RE01, RE04, RE02 (Special Frequencies), And RS01 (AC Magnetic Fields) Are Met By Existing NOAA/AMSU-A Instrument
- Minor Shielding And Hardness Changes Together With Improvements In Test Set Ups Will Improve CE03, RE02 (14kHz To 18GHz Narrowband) And RS03 (14kHz To 18GHz) Performance
- Recommended Deletion Of CE06 Requirement Because The AMSU-A Instrument Does Not Use A Shared Antenna
- Request Evaluation Of RS01 (DC Magnetic Field) Requirement To Establish Reality
- RS03 (Special Frequency) Requirement Cannot Be Met If Source Is In The AMSU-A Antenna Field Of View
- Additional Testing Will Be Required For CS02
- Preliminary Analysis Shows That Radiometric Shielding Effectiveness Appears Adequate In Existing NOAA/AMSU-A Instrument

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EOS/AMSU-A Environmental Requirements

Acceleration, Vibration, Shock, Launch Pressure, Acoustice

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AMSU-A Environmental Comparisons

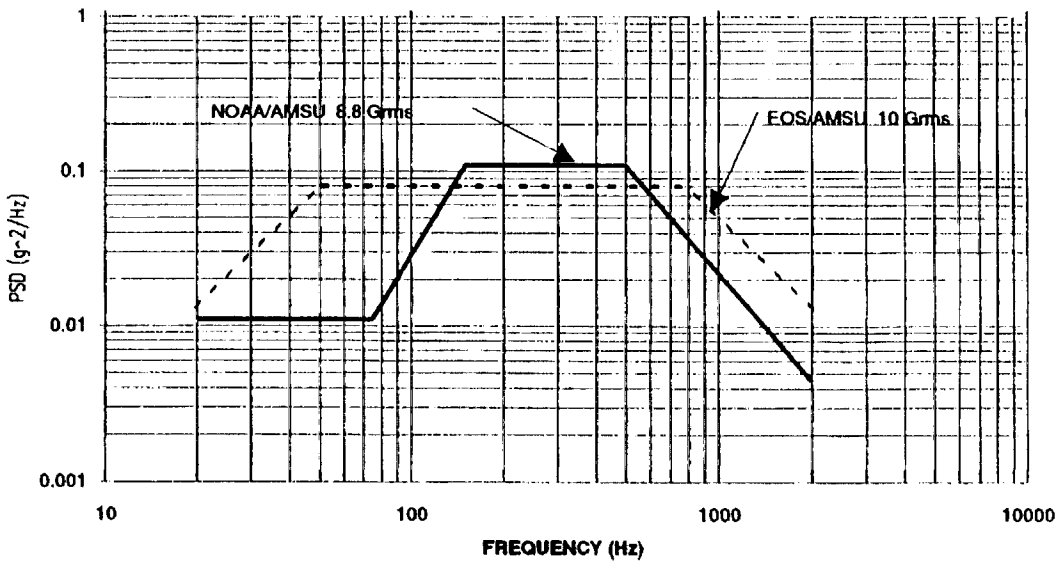
NASA

Acceleration:

	EOS	NOAA
Ultimate Load At CM (g's)	21	19.6 (min) 21.2 (max)

Random Vibrations:

PROTOFLIGHT LEVELS



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AMSU-A Environmental Comparisons

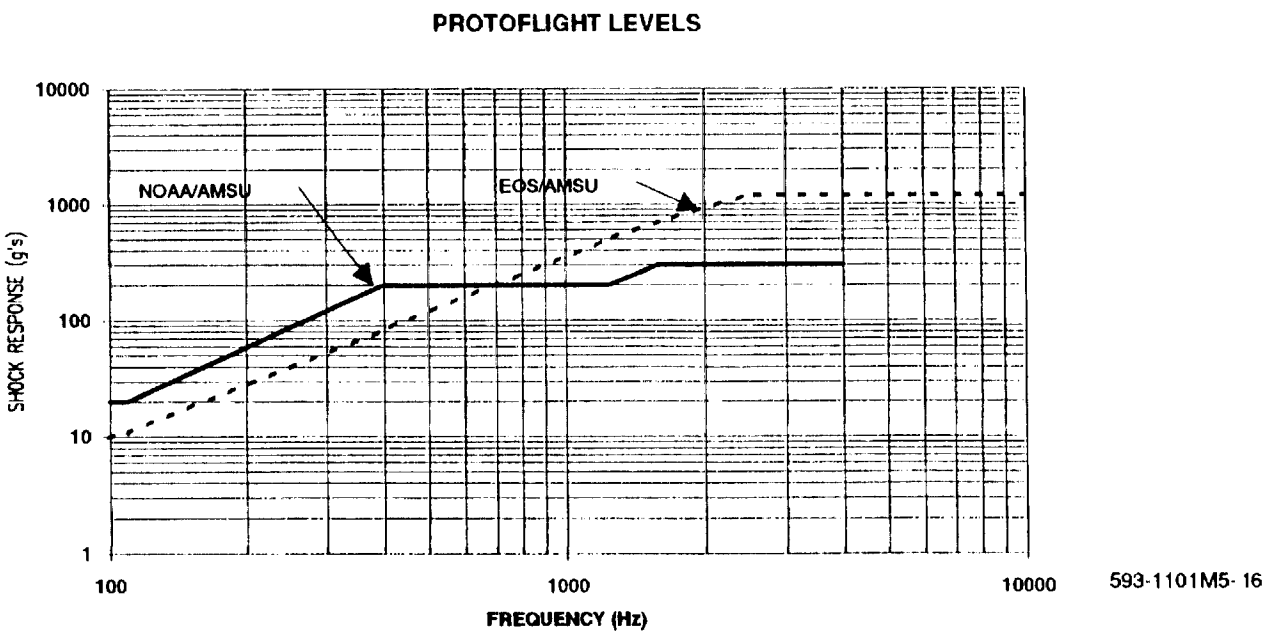
NASA

Sinusoidal Vibration

EOS: **Sine Sweep** — **5 To 18 Hz, Displacement = 12 mm**
18 To 50 Hz, 8 G Peak

NOAA: **Sine Burst** — **16.3 G Peak @ 40 Hz, 7 Cycles**

Shock



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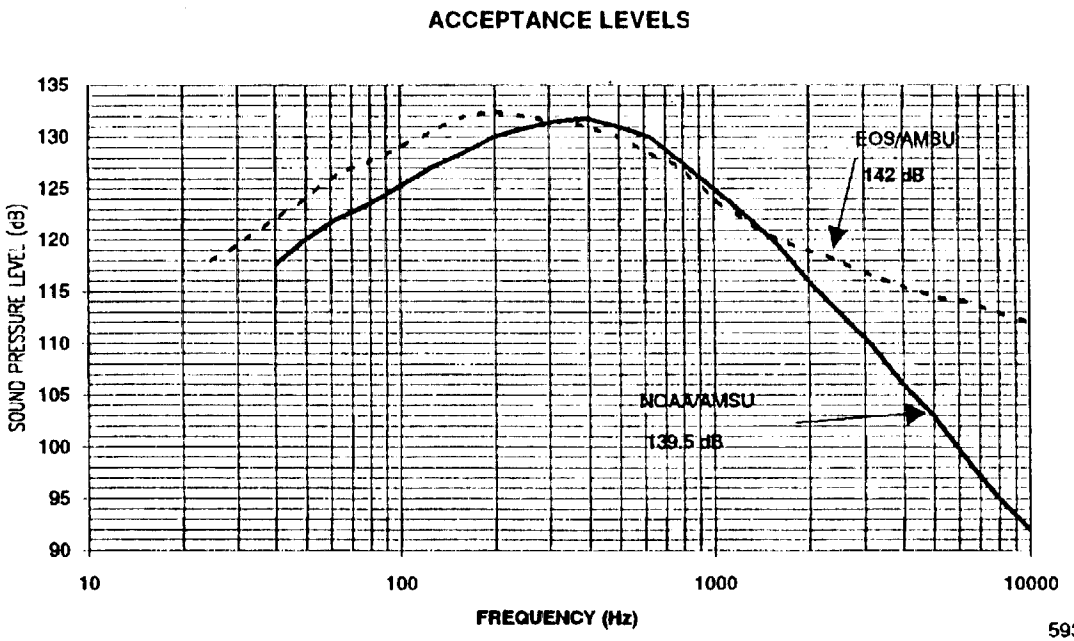
AMSU-A Environmental Comparisons

NASA

Launch Pressure Decay

	EOS/AMSU	NOAA/AMSU
Max Decay Rate (kPa/sec)	1.0	1.93

Acoustic Noise:



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AMSU-A Environmental Comparisons

NASA

- **Summary**
  - **EOS Pyroshock Is A New Requirement For AMSU. No Problems Are Anticipated**
  - **EOS Acoustic Noise Environment Is Somewhat (2.5 dB) Higher**
  - **Other EOS Environments Are Very Similar Or More Benign Than NOAA**
  - **EOS Environments Are Not Expected To Cause Design Changes To AMSU**

04 May 1993

EOS/AMSU-A ACTION ITEMS FROM 2, 3 FEBRUARY '93 INTERFACE MEETINGS

ACTION ITEM NO.	DESCRIPTION	RESPONSIBILITY	DUE DATE	DISPOSITION DATE, REF DOC.
2/2 - 1	AEROJET TO INVESTIGATE PLACING AN ALIGNMENT CUBE NEAR THE INTERFACE, PREFERABLY ON THE MOUNTING FLANGE. PROVIDE CONCEPT & ROM COSTS (NOTE: INCLUDE FLIGHT COVERS FOR CUBES IN ROM COSTS).	CHAPMAN/ELY	2/18	2/18, ISSUED WITH WEEKLY REPORT W/O ROM COSTS. 3/16 ROM FAXED TO TECHNICAL OFFICER
2/2 - 2	AEROJET TO PROVIDE UPDATED IDEAS MODELS IN UNV FILE FORMAT	CHAPMAN/ELY	2/18	2/18, MAG TAPE COPY SENT. 2/22, NASA ADVISED AEROJET-NEED MORE FLEXIBLE MODEL. ACTION ITEM REOPENED. 3/11, REVISED MODEL SENT.
2/2 - 3	AEROJET TO VERIFY SCAN DIRECTIONS, COLD CALIBRATION POSITIONS ANDFIELDS OF VIEW.	W. CHAPMAN	2/18	2/18, REVISED A-2 SCAN & COLD CALIBRATION FIGURES SENT WITH WEEKLY REPORT.
2/2 - 4	AEROJET AND GSFC TO VERIFY STABILITY REQUIREMENTS ON SPACECRAFT AND INSTRUMENT.	W. CHAPMAN	3/15	3/15, ISSUED WITH WEEKLY REPORT.
2/2 - 5	GSFC TO CONSIDER WAIVER OF HEAT TRANSFER THROUGH INTERFACE. (NOTE: PER NASA, AEROJET TO ASSUME REQUIREMENT WAIVED. WILL BE DOCUMENTED IN CONTRACT)	NASA	WITH CONTRACT FINALIZATION	
2/2 - 6	GSFC TO CONSIDER WAIVER OF SURVIVAL HEATER POWER LIMIT.(NOTE: PER NASA, AEROJET TO ASSUME REQ. WAIVED. WILL BE DOCUMENTED IN CONTRACT.)	NASA	WITH CONTRACT FINALIZATION	
2/2 - 7	AEROJET TO PROVIDE LIST OF CLEANING MATERIALS TO BE AVOIDED DURING I&T.	W. CHAPMAN	NEXT I/F MTG 5/10	5/11. SEE INTERFACE MEETING BOOK.
2/2 - 8	AEROJET TO IDENTIFY CONTAMINATION SOURCES -- MATERIALS, QUANTITIES, AND LOCATIONS.	W. CHAPMAN	NEXT I/F MTG 5/10	5/11. SEE INTERFACE MEETING BOOK.
2/2 - 9	AEROJET TO PROVIDE TEMPERATURE/HUMIDITY REQUIREMENTS APPLICABLE DURING I&T.	W. CHAPMAN	NEXT I/F MTG 5/10	5/11. SEE INTERFACE MEETING BOOK.
2/2 - 10	GSFC TO CONSIDER WAIVER TO PEAK POWER TURN-ON TRANSIENT DURATION. (NOTE: PER NASA, AEROJET TO ASSUME REQ. WAIVED. WILL BE DOCUMENTED IN CONTRACT.)	NASA	WITH CONTRACT FINALIZATION	

04 May 1993

EOS/AMSU-A ACTION ITEMS FROM 2, 3 FEBRUARY '93 INTERFACE MEETINGS

ACTION ITEM NO.	DESCRIPTION	RESPONSIBILITY	DUE DATE	DISPOSITION DATE, REF DOC.
2/2 -11	AEROJET TO REVISE PASSIVE ANALOG TEMPERATURE MONITORING CIRCUIT. PROVIDE CONCEPT AND ROM COSTS.	M. PLUCK	3/15	3/15, ISSUED WITH WEEKLY REPORT.
2/2 - 12	AEROJET TO INDICATE DURATION OF SOLAR VIEWING THAT WILL NOT RESULT IN DEGRADATION OF THE INSTRUMENT (IN SURVIVAL MODE).	R. KRYLO	NEXT I/F MTG 5/10	5/11. SEE INTERFACE MEETING BOOK.
2/2 - 13	AEROJET TO PROVIDE RADIOMETRIC SENSITIVITIES. (SEE TABLE 1, SPEC) (DISCUSSION WAS RE: LO, RECEIVER)	W. CHAPMAN	NEXT I/F MTG 5/10	5/11. SEE INTERFACE MEETING BOOK.
2/2 - 14	AEROJET TO PROVIDE EMI/EMC SENSITIVITIES, e.g., TRANSMITTERS.	M. PLUCK	NEXT I/F MTG 5/10	5/11. SEE INTERFACE MEETING BOOK.
2/2 - 15	AEROJET TO VERIFY TORQUE VS. PRELOAD FOR MOUNTING BOLTS.	W. ELY	NEXT I/F MTG 5/10	5/11. SEE INTERFACE MEETING BOOK.
2/2 - 16	GSFC TO CHANGE SPECIFICATION TO UPDATE ENVELOPES	NASA	AS SPEC IS UPDATED	MARCH 93. SPEC RELEASED.
2/2 - 17	AEROJET TO INDICATE KEEP OUT ZONES AROUND INSTRUMENTS FOR SPACECRAFT MOUNTING AND SERVICING.	W. CHAPMAN	NEXT I/F MTG 5/10	2/24, ENVELOPES RECOMMENDED IN MARKED UP SPEC SENT TO TECHNICAL OFFICER.
2/2 - 18A	GSFC TO PROVIDE KINEMATIC MOUNT MEMO AND MODELS	NASA	2/3/93	RECEIVED 2/3 AT GSFC
2/2 - 18B	AEROJET TO ANALYZE IF KINEMATIC MOUNT IS NEEDED BASED ON MEMO.	W.ELY	NEXT I/F MTG 5/10	5/11. SEE INTERFACE MEETING BOOK.
2/2 - 18C	AEROJET TO REVIEW MODELS THERMAL FINITE ELEMENT	R. KRYLO W. ELY	3/15	3/15, COMMENTS ON EACH MODEL ISSUED WITH WEEKLY REPORT.
2/2 - 19	NASA TO CONSIDER WAIVER OF 50 IN- LB LIMIT ON TORQUE. AEROJET TO PROVIDE RECOMMENDED VALUE	W. ELY	NEXT I/F MTG 5/10	3/19, ISSUED WITH WEELY REPORT (60 IN-LBS RECOMMENDED). WILL ALSO INCLUDE IN NEXT I/F MEETING.

04 May 1993

EOS/AMSU-A ACTION ITEMS FROM 2, 3 FEBRUARY '93 INTERFACE MEETINGS

ACTION ITEM NO.	DESCRIPTION	RESPONSIBILITY	DUE DATE	DISPOSITION DATE, REF DOC.
2/2 - 20	PROVIDE ROM COST FOR 1553 WITH EMBEDDED TIME CODE	M. PLUCK	2/4	2/4/93, FAXED TO TECHNICAL OFFICER
2/2 -21	CS 06- 24 VOLT SPIKE ACCOMMODATION - ASSESS IMPACT.	M. PLUCK	NEXT I/F MTG 5/10	5/11. SEE INTERFACE MEETING BOOK.
2/2 - 22	AEROJET TO COMPLETE THE EMI/EMC ASSESSMENT (GIRD REQUIREMENTS)	CHAPMAN/PLUCK	3/15	3/15, ISSUED WITH WEEKLY REPORT.
2/2 - 23	AEROJET TO APPOINT REPRESENTIVE FOR AIRS,/AMSU-A/MHS SCIENCE TEAM	D. HOWELL	3/15	3/15, ISSUED WITH WEEKLY REPORT.
2/2 - 24	REVISE MOMENT OF INERTIA UNITS TO Kg - m^2	W. CHAPMAN	2/26	2/26, ISSUED WITH WEEKLY REPORT.

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Action Item Summary

NASA